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I

THE ANNALS

AND

MAGAZINE OF NATURAL HISTORY,

INCLUDING

ZOOLOGY, BOTANY, AND GEOLOGY.

(BEING A CONTINUATION OF THE 'ANNALS' COMBINED WITH LOUDON AND CHARLESWORTH'S 'MAGAZINE OF NATURAL HISTORY.')

CONDUCTED BY

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1866.

"Omnes res creatæ sunt divinæ sapientiæ et potentiæ testes, divitiæ felicitatis humanæ:—ex harum usu *bonitas* Creatoris; ex pulchritudine *sapientia* Domini; ex œconomiâ in conservatione, proportione, renovatione, *potentia* majestatis elucet. Earum itaque indagatio ab hominibus sibi relictis semper æstimata; à verè eruditis et sapientibus semper exculta; malè doctis et barbaris semper inimica fuit."—LINNÆUS.

"Quel que soit le principe de la vie animale, il ne faut qu'ouvrir les yeux pour voir qu'elle est le chef-d'œuvre de la Toute-puissance, et le but auquel se rapportent toutes ses opérations."—BRUCKNER, *Théorie du Système Animal*, Leyden, 1767.

. . . . The sylvan powers
Obey our summons; from their deepest dells
The Dryads come, and throw their garlands wild
And odorous branches at our feet; the Nymphs
That press with nimble step the mountain-thyme
And purple heath-flower come not empty-handed,
But scatter round ten thousand forms minute
Of velvet moss or lichen, torn from rock
Or rifted oak or cavern deep: the Naiads too
Quit their loved native stream, from whose smooth face
They crop the lily, and each sedge and rush
That drinks the rippling tide: the frozen poles,
Where peril waits the bold adventurer's tread,
The burning sands of Borneo and Cayenne,
All, all to us unlock their secret stores
And pay their cheerful tribute.

J. TAYLOR, *Norwich*, 1818.

ALERE FLAMMAM.

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Errata.

Page 230, *for* Grinders 6/6 *read* Grinders $\frac{6}{5}$; for *O. Geoffroyia* read *O. Godeffroyi*.

" 235, for *Grinders* 6/6 read *Grinders* $\frac{6}{5}$.

" 288, line 14 from bottom, and p. 291 *et seq.*, for *Polythoa* read *Palythoa*.

" 362, line 12, *for* diapophysis *read* diaphysis.

" 421, line 20, *for* Halecidæ *read* Haleciidæ.

" 422, line 23, *for* that traverses *read* which traverses.

" 423, line 25, *for* away any invaders *read* away invaders.

THE ANNALS

AND

MAGAZINE OF NATURAL HISTORY.

[THIRD SERIES.]

"................. per litora spargite muscum,
Naiades, et circùm vitreos considite fontes:
Pollice virgineo teneros hìc carpite flores:
Floribus et pictum, divæ, replete canistrum.
At vos, o Nymphæ Craterides, ite sub undas;
Ite, recurvato variata corallia trunco
Vellite muscosis e rupibus, et mihi conchas
Ferte, Deæ pelagi, et pingui conchylia succo."
N. Parthenii Giannettasii Ecl. 1.

No. 103. JULY 1866.

I.—*Description of a new Species of Marine Worm* (Phenacia pulchella). By Edward Parfitt.

[Plate I.]

To the Editors of the Annals and Magazine of Natural History.

Gentlemen,

I beg to introduce to your notice a very beautiful new species of marine worm; it was cast up at my feet by the waves at Exmouth, January 6th, during a heavy gale. I forwarded a rough sketch of it to my friend Dr. Baird, of the British Museum, who informed me it was new to him, and that he could find no description of it. In M. de Quatrefages's "Classification of the Annelides," published in the 'Annals' for January last, p. 22, he has separated the genus *Sabellidis*, and raised those species with simple buccal cirri to the rank of a new genus, *Phenacia*; and it is to this genus that the present species belongs: it will therefore stand thus:—

Family XXV. Terebellea.

Genus Phenacia, Quatrefages.

Phenacia pulchella, mihi.

Body composed of about forty annulations, the anterior compressed and rugose, short, but gradually growing longer

towards the posterior end, which is thickened and rugose. The anterior annulations are armed with two fascicles of yellow bristles, of about three or four each, placed opposite to each other: the rest of the rings have about two each; but the numbers vary. Colour pale orange-red, the mouth with a purple cast. Buccal cirri twenty, ten on each side of the oral organ, white, beautifully maculated with oblong spots of orange-red down the centre. Dorsal cirri reflexed, purple, with a faint reddish tinge.

Length of the worm 2 inches, of the tube 3 inches; diameter at larger or anterior end 2 lines.

This species constructs a rather flexuose tube made of a thin horny substance similar to that of the polypidoms of the Sertularias, and coated with grains of sand and comminuted shells, with bits of corallines attached.

The worm is able to raise its head considerably above the first or anterior ring, bearing the dorsal cirri, as shown in the figure (Plate I.) on the right. Generally speaking, its movements were slow; but when fully protruded it is a beautiful creature, the dorsal cirri contrast so strongly with the delicately painted buccal organs. I kept it alive for several days, and I found that it seldom protruded itself by day; but as evening closed in it would then develope itself to its fullest extent.

I am, Gentlemen,
Yours obediently,
EDWARD PARFITT.

Devon and Exeter Institution,
April 21, 1866.

II.—*On the Affinities of* Peridinium Cypripedium, *Jas-Clk., and* Urocentrum Turbo, *Ehr.* By Prof. H. JAMES-CLARK, A.B., B.S., Soc. Am. Acad.

IN the 'Proceedings of the American Academy' of February 1865 I published a paper on the anatomy and physiology of *Peridinium Cypripedium*, mihi. That article, with the accompanying plate, was copied into the 'Annals and Magazine of Natural History' for October 1865. In the December Number of the same 'Annals' I find some remarks on my paper by Mr. H. J. Carter, the principal aim of which is to show that the animal which I have described is not a *Peridinium* but a *Urocentrum*. I wish, through the medium of your Magazine, to give my reasons why I did not formerly, and do not now, believe that the identification of that gentleman can be sustained.

Let me state, in the first place, that the whole question hinges on the identification of the animal as described and figured by

Ehrenberg, and in no way is dependent upon the affidavit of Claparède and Lachmann. The latter can lay no greater claim to correctness than Mr. Carter in this respect; and all are equally liable to a misapprehension of the nature of the infusorian as described by Ehrenberg. The fact that the authors of the 'Études' found the animal in question, as they think, in Berlin, as it were under the very eyes of Ehrenberg, renders the identification no more certain than the discovery of the same by Mr. Carter, as he thinks, far off in England.

I cannot help deprecating the confidence with which Mr. Carter pronounces upon what he calls my mistake, seeing that his judgment is based upon a description at second-hand, as I infer from his quotation of Ehrenberg's statements from the 'Micrographic Dictionary.' The basis for an identification is meagre enough in the work of the Berlin micrographer; and how much less satisfactory in the Dictionary of Griffith and Henfrey, every one knows who has compared the two books. Messrs. Claparède and Lachmann frequently find occasion to deplore the unsatisfactory character of the descriptions and figures of Ehrenberg; but if they never had cause to complain before, it must have occurred when they attempted to decipher the illustrations of *Urocentrum* on plate 24 of the 'Infusionsthierchen.' For my own part, I felt the same restraint when originally working up my article; and Mr. Carter must pardon me therefore when I say that I cannot see the necessity or the proper basis for his *ex cathedrâ*, even though he may swear upon the original work itself. I am, however, far from attributing to your distinguished authority upon the group of Protozoa the singular fancy, possessed by some, for deciphering the obscure two-line descriptions of the old-time species-makers; still less would I suppose him capable of that remarkable mania for identifying such zoological vagaries as those of Rafinesque with this or that animal simply because it came from the same locality as that named by that singular enthusiast.

Since, however, Mr. Carter has so positively pronounced upon this matter, I am compelled to assume the figures and description of Ehrenberg to stand in the place of the animal itself, and not what others may happen to think it ought to be. Ehrenberg says, in his generic diagnosis of *Urocentrum*, "corpore non ciliato, fronte ciliis coronata." Now in *Peridinium Cypripedium* all of the body (excepting the broader end, which is occupied by the *pseudo-cuirass*) is covered with cilia, and there is no such thing as a *corona* of cilia upon it. The anterior and posterior transverse annular furrows seem to be bands of *vibrating cilia* simply because these cilia are only rather more crowded along the edges of the furrows than elsewhere. The mouth of *Uro-*

centrum is stated to be at the anterior edge of the ventral face: "Fig. 1 von der Seite gesehen, Bauchfläche rechts mit dem Munde am vorderen Rande." In *Peridinium Cypripedium* this aperture is on the ventral side and about halfway between the two ends of the body—a position which it seems to occupy in many of the Peridiniæa.

Although I do not use the word *spiral* in regard to the mouth and œsophagus, it can hardly be said that I "mention nothing spiral" about them; for I think that the illustrations tell as much as the text; and any one who will inspect my figures 2 & 3 will see that the position of the mouth in the first, and the trend and curve of the œsophagus in the second, are sufficiently indicative of a spiral arrangement of these parts. The text fully bears out this assertion, in the following words (p. 397; Annals, p. 274):—"The mouth lies altogether within the posterior obliquely transverse furrow (*pf*), and extends from its anterior to its posterior edge, trending diagonally across the axial plane of the body, from the right, backwards, towards the left;" and on p. 398 (Annals p. 275), "From the mouth the œsophagus (*œ*) passes obliquely backwards and towards the dorsal region, at least halfway through the body, and then terminates rather abruptly just before the contractile vesicle, but a little to the right side (fig. 3 *œ*) of the axial plane." Lest, however, there should be any further doubt in regard to my views upon this point, I will state now that the arrangement of the mouth and œsophagus is decidedly spiral, and unequivocally stamps this animal as a member of the læotropic division of Infusoria Ciliata.

As to the systematic position of this *Peridinium*, its læotropic character at once removes it out of the division to which the Vorticellina belong; but yet when we see that one of the latter family, viz. *Trichodina Pediculus*, Ehr., has its contractile vesicle on the left side of the body, instead of on the right—thus partially reversing the relationship of the organs as exhibited in the other members of that group (see my paper in the Mem. Boston Soc. Nat. Hist. vol. i. 1866), and that it totally lacks the protrusile vibratory disk, so eminently characteristic of the Vorticellidæ—and when, again, we call to mind the ciliated body of another Vorticellidan, viz. Claparède's *Trichodinopsis*, the way appears clear for the close approximation to the Vorticellina of the totally ciliated Tintinnoidea with their terminal, depressed, cyathiform front, bordered by the crown of cilia, which terminates, according to Claparède, by passing into the excentric mouth: and then, as a succeeding step, it does not seem at all improbable that the Peridiniæa, judging from the characters of *P. Cypripedium*, should have a not very remote affiliation with

the same group that the Tintinnoidea border upon. The apparently low organization of some of the Peridiniæa does not invalidate their approximation, through the higher forms, to the Tintinnoidea, any more than the inferior organization of the Cyclopidæ depresses the whole class of Crustacea below the level of the group of worms.

In this connexion I would mention that I do not believe that the so-called Cilio-Flagellata are distinct, as an order, from the Flagellata. I will not deny that the former, as well as the latter, have more intimate relations among themselves than exists between the two groups; but at the same time there are some (as, for instance, *Prorocentrum*) among the Cilio-Flagellata which hold their position there by a quite doubtful tenure—the few cilia at the anterior end indicating merely a preponderance in favour of their affiliation with that group, rather than a positive claim to be so united. The lorica gives to *Prorocentrum* the habit of a Peridinian, and may add a little to the strength of the argument which the cilia afford; but, on the other hand, there is a new genus of Infusoria which I have described in a recent work* under the name of *Heteromastix* (*H. proteiformis*), which possesses all the habits, actions, mode of progression, and general appearance of a true flagellate infusorian, very much like a *Heteromita*, Duj., and is endowed with two anteriorly subterminal flagella—the one acting as a proboscis or tentacular organ, and the other as a trailer or moveable keel; but at the same time the ventral anterior half of the body is hollowed out by a broad median furrow, which is thickly lined with locomotive cilia—thus presenting a peculiarity not heretofore deemed admissible as a characteristic of Flagellata, but, on the contrary, as appertaining alone to the Cilio-Flagellata.

I would remark here, moreover, that in view of the fact that *Peridinium Cypripedium* possesses, beside the median transverse sulcation, an *anterior* annular furrow, and immediately in front of it a low skullcap-like covering, or *pseudo-cuirass* (both of which Mr. Carter appears to have been inattentive to in perusing my article), it seems possible that this infusorian may turn out to be generically different from any other Peridinian described hitherto. This looks so highly probable that I will propose the name *Peridinopsis* for it.

Since my commentator has gone so far as to doubt even the specific diversity of these two infusorians, I would add, in regard to the species *Urocentrum Turbo*, that Ehrenberg describes and

* 'Mind in Nature,' by H. James-Clark, pp. 330, with over two hundred illustrations. New York, 1866.

figures it as having an ovate three-cornered body, "corpore ovato triquetro," and states that the *stylus* or tail equals one-third the length of the body, "stilo tertiam corporis partem æquante;" whereas the American *Peridinium* has an "oblique pyriform outline," and the so-called flagellum is at least half as long as the body.

Between the statements of Ehrenberg and Claparède there is such a marked discrepancy that I am pretty well convinced that the testimony of the latter cannot by any means be used as an adjunct to the description of the former; for whilst Ehrenberg speaks of the "corpore non ciliato, fronte ciliis coronata," Claparède states (p. 76), in the first place, that there are no other organs than the buccal cirri, but that (p. 135) "it is the inferior part of the [*transverse median*] furrow that carries the buccal cirri;" and secondly, that "the mouth is not placed where Ehrenberg figures it [*i. e.* at the anterior edge of the ventral plane], but is lodged in the transverse median furrow which that author represents."

Supposing, now, the animal of Ehrenberg to be the same as that of Claparède, and the one described by me likewise identical with the former, then we must believe that Claparède has committed a great oversight in not seeing the most prominent and conspicuous cilia, in the region of the anterior annular furrow, as described by me, and which, in this assumed case, are in a corresponding position with the vibrating cilia-crown about the anterior, flat, frontal plane ("um die vordere flache Stirnfläche einem wirbelnden Wimperkranz") which Ehrenberg describes. It hardly seems possible that Claparède should have detected the smaller cilia in the median transverse furrow and overlooked the larger and more conspicuous ones, whilst Ehrenberg, with his far less powerful lenses, appeared to find no difficulty in making out the latter. It seems therefore much more plausible that the *Urocentrum* of Ehrenberg is not the same as that of Claparède, and certainly more likely that the latter should have failed to appreciate the value of the observations of the former upon the anterior cilia-crown than that he should have overlooked it were it really present.

I scarcely need add, therefore, that I am at least equally confident, if not fully satisfied, that *Peridinium Cypripedium* is not the same as the *Urocentrum* of Claparède.

Cambridge, Mass., May 12, 1866.

III.—*On the Vascular and Nervous Apparatus of the Larvæ of the Marine Crustacea.* By M. Z. Gerbe*.

Vascular Apparatus.—The larvæ of the Crustacea, whatever form they may present, are at first completely destitute of branchiæ; or if they possess them, these organs are quite rudimentary, and do not yet fulfil any function. Respiration, in this state, is performed by the whole of the general envelope. Even in the Lobsters, which are hatched with tolerably large branchiæ, the primitive respiration is absolutely tegumentary; for these appendages are impermeable to the blood until the third moult; and when they begin to perform their functions, the number of blood-globules which they admit is excessively small relatively to the mass of those which flow to the heart without traversing them. From this modification of the respiratory act there results a circulation of the greatest simplicity—the blood which the arteries have distributed in all parts of the body returns directly to the heart without passing through any special apparatus.

The heart, of all the organs exhibited by the Crustacea at their birth, is that of which the general form undergoes the least amount of subsequent change. In the larvæ it differs very little from what it is in the adult Crustacea; and it invariably occupies in the larvæ its definitive position, under the superior wall of the cephalothorax and above the pyloric portion of the intestine. In the *Zoëæ* (larvæ of Brachyurous Decapods) it is found immediately at the base of the temporary spine which rises from the middle of the thorax.

With the exception of the larva of the *Nymphon* of our coasts†, in which I have never yet succeeded in seeing the heart distinctly, all the Crustacea of which I have been able to study the metamorphoses‡ have the central organ of the circulation composed, at all ages, of two very distinct parts—one enveloped, the other enveloping, and bound together only by a few muscular bands, the action of which is manifested during diastole.

The enveloped portion evidently corresponds with the arterial heart of the higher animals. It consists of a sort of contractile

* Translated by W. S. Dallas, F.L.S., from the 'Comptes Rendus,' April 23, 1866, pp. 932–937.

† The larva of this *Nymphon* is exceedingly curious, both in its external form and in its internal organization, and it differs from the adults as much as the Phyllosomes from the *Palinuri*, or the *Zoëæ* from the various Crabs to which they belong. The body is not at all articulated; and the true legs, which are only two in number, have only two joints and a terminal claw. I propose, however, to make them the subject of a special notice.

‡ See 'Comptes Rendus,' 26th December, 1864.

sac, varying in form according to the species, with internal muscular columns and delicate transparent walls, formed of longitudinal and annular muscular fibres intercrossed in various directions; it presents on each side a single semilunar fissure, to which a valve of the same form is adapted internally. From this contractile sac issue all the arteries which perform the distribution of the blood.

The second sac, which is much larger and has its walls thinner and less muscular, completely envelopes the arterial heart, and communicates by two or three oblong apertures with the same number of large venous lacunæ, which convey the blood to the heart. This enveloping portion of the central circulatory organ has been assimilated to the pericardium of the red-blooded animals. In this assimilation there is an appearance of truth, if we consider only the form; but it is far from being exact if we take into account the function, which is very different in importance from the form. The pericardium in the Vertebrata is an organ closed everywhere, without any communication either with the cavities of the heart or with the vessels which run to it; here, on the contrary, the sac which has been assimilated to the pericardium directly receives all the blood into its cavity and transfers it to the ventricle. It is intermediate between the venous lacunæ and the arterial heart, and fulfils exactly the part which, under another form, the auricle, in fishes for example, performs with relation to the *venæ cavæ* and the ventricle. By its functions, therefore, this second cavity would be the analogue of the auricular portion of the heart in Vertebrata.

Five arterial branches issue from the anterior extremity or half of the central contractile sac; only one springs from its posterior extremity. Of the five anterior arteries, one (the ophthalmic artery) follows the median line, passes directly to the brain, and is distributed in the ocular peduncles. In those species in which the rostrum in the young state acquires the form of a long spine, the ophthalmic artery is produced to the extremity of this appendage, after having furnished a branch to each eye. This arterial branch, which is one of the largest, is furnished at its issue from the heart with a double valve, or rather with two opposite flaps, separated at the base, in contact at the apex, which alternately open and close to let pass the globules of the blood and prevent their flowing back into the heart. The action of these flaps, which is completely independent of the contractions of the central organ, is sometimes slow, sometimes rapid; frequently it is even suddenly and momentarily suspended. Two other branches, one on each side, originating a little behind the preceding, also run forward,

following an oblique line, which removes them from the median or ophthalmic artery, emit, in passing, a branch to the rudimentary cæca which represent the liver, and distribute themselves at the base of the outer antennæ. Lastly, the two remaining arteries, at their issue from the arterial heart, are immediately reflexed downwards and lost beneath the liver and upon the sides of the stomach. These four arteries have their base furnished with a simple valve.

The artery which springs from the posterior extremity is generally as voluminous as the anterior median artery. In the Phyllosomes it follows the dorsal line of the intestine for some distance, and then, on arriving at the level of the nervous ganglia of the third pair of true feet, it bends, passes on the left side of the intestinal tube, and divides into two trunks. One of these, which is very large, traverses the ganglionic chain, ascends as far as the mouth, and gives off to the right and left a branch to each of the ambulatory limbs and buccal appendages: it represents the sternal artery. The other, which is very slender, descends to the last abdominal segments, following the course of the intestine, and emits, in its course, a branch to the rudimentary buds which represent the fourth and fifth pairs of true legs.

In the Zoëa-form larvæ, in those of the *Porcellanæ*, Crangons, Lobsters, &c., the posterior artery, instead of dividing only after passing a certain distance, bifurcates at its issue from the heart. One of its branches runs directly down to form the sternal artery, after having traversed the thoracic ganglionic mass at the same point as in the Phyllosomes; the other branch follows the intestine to its extremity, remaining of a considerable size throughout. This branch, which answers to the superior abdominal aorta of the adult Crustacea, presents, in the young Lobsters, a very remarkable peculiarity: on its course, at a distance from the heart and a little above the constriction which separates the intestine into the duodenum and rectum, it has a sort of sphincter or circular valve, which contracts absolutely in the same manner as the pupil of the eye of the cat. Its contractions, which occur at indeterminate periods, progressively and slowly, have the effect of obliterating, entirely or partially, the calibre of the artery, so as to suspend, for some seconds, the circulation in the postabdomen, or to moderate the flow of blood towards that region. This fact is so exceptional that I cannot but call the attention of physiologists to it.

All the arteries, whatever be their size, have their extremities bevelled, and terminate suddenly in a venous lacuna by an oval opening, usually a little dilated into a trumpet-shape.

The venous circulation in the larvæ, as in the perfect animals, is rather lacunar than vascular. The blood which the arteries have distributed to all parts of the body, returns indeed by constant and determinate courses; but these courses consist of a succession of cavities which the organs leave between them, cavities in which it is difficult to ascertain the existence of proper walls or of regular forms. Thus this mode of circulation baffles description. All that can be said in a general way is, that three principal perfectly limited currents, two anterior and lateral and one posterior and median, open into the heart. The two former, in the Phyllosomes, are caused by the fluids which circulate in the cephalic buckler alone; the third is formed by those which arrive from the true feet, the thorax, and the abdomen. In the larvæ of the other Macrurous Decapods and in those of Brachyura, on the contrary, the fluids distributed to the head and thorax combine to form the lateral currents, whilst the posterior current is produced solely by the blood returning from the abdomen.

The elements of the blood in the first age of the Crustacea consist of a perfectly colourless liquid, and small, isolated, diaphanous corpuscles, some oblong or square, others angular or virguliform, with the outlines very distinct, but always very irregular, even when these kinds of globules affect a more or less rounded form.

Nervous Apparatus.—The nervous system of the larvæ of the Crustacea is composed, like that of the perfect individuals, of a double series of ganglia or medullary masses, in which the nerves of all parts of the body terminate. United to each other by longitudinal cords, these ganglia, which are the more voluminous in proportion as the organs of the life of relation to which they correspond are more developed, form a continuous system upon the median line, extending from the base of the ocular peduncles to the last joint of the abdomen. Nevertheless, taking into consideration the regions occupied by it, the central nervous apparatus may be divided into a cephalic, thoracic, and abdominal portion.

The cephalic portion, or brain properly so called, is composed, both in the Phyllosomes and in the *Zoëæ* and other larvæ of Macrurous and Brachyurous Decapods, of a single ganglionic mass, situated between the bases of the rudimentary antennæ and symmetrically divided into three unequal pairs of lobes, each of which furnishes a sensorial nerve. From the two anterior lobes spring the optic nerves, which pass directly into the ocular peduncles; from the two middle ones arise the inner antennary nerves, and from the two posterior the nerves which are distributed in the outer antennæ and to the auditory organ

situated at their base. Each of these lobes likewise furnishes a pair of nerves running to the muscles and the integuments.

Two cords issuing from the posterior lobe of the brain and united by an ante-œsophageal commissure, place this organ in communication with the thoracic portion of the central nervous system. These two cords, which are exceedingly short in the larvæ of the Prawns, *Porcellanæ, Maiæ, Portuni,* &c., and rather more extended and thickened in the Lobsters, are excessively long and slender in the Phyllosomes, in which they also present a second commissure behind the brain.

But it is especially in the arrangement of the ganglia of the thorax that the larvæ of the *Palinuri* are distinguished from those of other Decapods that I have been able to observe. In the latter, the thoracic nervous system, represented by the five pairs of ganglia related to the buccal appendages, and by the five pairs corresponding with the ambulatory feet, forms a single oblong mass, pierced at the level of the third and fourth pairs of true feet for the passage of the sternal artery—a mass in which the ganglia are so intimately connected that sometimes, as for example in the *Porcellanæ,* scarcely perceptible furrows mark their separation. Each of these ganglia furnishes two pairs of nerves: one issues directly from the central medullary nucleus, the other appeared to me to be intimately connected with the nervous portion which forms the commissures. Their origin would therefore be different.

In the Phyllosomes the thoracic nervous system certainly forms a double chain as in the other species, but the ganglia, instead of being grouped in such a manner as to form a body, are, on the contrary, very distant from each other, their only communications being formed by rather long longitudinal and transverse commissures. Moreover the volume of these ganglia is excessively unequal, being in relation to the development of those organs to which each of them corresponds. The masticatory appendages, the first pair of footjaws, and the true feet of the fourth and fifth pairs being rudimentary or incomplete in the Phyllosomes, the ganglia devoted to these parts likewise present themselves in a rudimentary state.

The concordance which I have just indicated is still more manifest in the portion of the nervous apparatus which belongs to the abdominal region. This region, where everything in the Phyllosomes is in the condition of a mere sketch (the segments of which it is composed, as well as the false legs of which the successive moults cause the appearance), instead of six pairs of ganglia which may be detected in it in individuals furnished with their abdominal appendages, presents nothing but the prolongations of the two nervous cords or longitudinal

commissures, upon which very slight swellings, representing the future ganglia, may barely be perceived.

In the larvæ of the Lobster, on the contrary, and in those of the *Zoëa*-form in which the abdomen is well developed, we see the double ganglionic chain from the very first, formed, as it will be subsequently, of six pairs of ganglia, already of considerable size, and bound together by the longitudinal commissure. Here, as in the thoracic portion of the central system, two pairs of nerves issue from each of the ganglia and from the cords by which they are connected.

IV.—*On the* Menispermaceæ.

By John Miers, F.R.S., F.L.S. &c.

[Continued from vol. xvii. p. 270.]

29. Stephania.

This genus, proposed by Loureiro in 1793 for two plants of Chinese origin, was for a long time wholly neglected; at length it was acknowledged by botanists, and so far extended by some as to embrace Blume's genus *Clypea*; others, on the contrary, under vague notions of its real characters, gave the preference to *Clypea*, and included in it all the species of *Stephania*. The authors of the 'Flora Indica' and of the 'Genera Plantarum' have united the two genera, on the authority of Prof. A. Gray, who placed little dependence on the constancy of their relative distinctions as I had defined them: his doubts arose from the examination of a plant considered by him to be identical with *Cocculus Forsteri*, DC., which had been referred to *Stephania*; it appeared to him that its floral parts were sometimes 3-merous, at other times 4-merous, in the same specimen—an inference upon which I offered some remarks in speaking of *Clypea* (vol. xvii. p. 268). In all the instances examined by me, which are extremely numerous, I have found, without exception, that the floral parts in the two genera are constantly different in number. *Stephania* in its ♂ flower has six sepals in two series, three smaller petals, and a 6-celled anther; while *Clypea*, as I have shown, has eight sepals in two series, four petals, and an 8-celled anther. In *Stephania* the ♀ flower has three sepals, three petals, and a putamen with a remarkable perforation in the middle of its disciform condyle; while *Clypea* has four sepals, two petals, and a putamen with an imperforated condyle, as in *Ileocarpus* and *Cissampelos*. Many good characters also separate this genus from *Homocnemia* and *Ileocarpus*: although the latter has a similar number of sepals and petals, the imperforation of its condyle renders it distinct; the former has four sepals and

four petals in the ♀ flower, its fruit being unknown. Ignoring these well-marked distinctions, the authors of the 'Genera Plantarum' amalgamate *Clypea*, *Ileocarpus*, and *Homocnemia* with *Stephania*, and in the four genera thus confounded together they recognize only three species, whereas I have here enumerated, under well-defined characters, twenty-six species of *Stephania*, nine of *Clypea*, one of *Ileocarpus*, and one of *Homocnemia*, making in all thirty-seven species. Much perplexity has arisen from the incomplete characters of the several species hitherto described by botanists, so that it has been difficult to reduce into consistent order many of the plants that have been referred to them; and, to add to this confusion, most of the specimens now existing in herbaria appear to have been named at hazard: no one seems to have taken the trouble to examine the structure of the flowers, in which, notwithstanding their minute size, good characters are found, corroborative of other features obtainable from the differences that exist in the leaves, petioles, and inflorescence.

The species are found chiefly on the Indian continent and the islands of its great archipelago, their range extending eastward as far as China, Japan, and Australia, and westward to the limit of Africa: the genus is therefore quite foreign to the continent of America. It may be here observed that the hairs of the pubescence, whenever found in this genus, are short and articulated, as they are likewise in *Clypea*.

STEPHANIA, Lour.;—Clypea, *W. & A.* (*non Bl.*);—Cissampelos (*in parte*) *auctorum*;—*Flores* dioici. *Masc. Sepala* 6, spathulato-oblonga vel linearia, biseriata, quorum 3 interiora latiora, membranacea, æstivatione imbricata. *Petala* 3, sepalis exterioribus opposita, cuneato-rotunda vel ovata, breviora, carnosula. *Stamen* unicum, centrale; *filamentum* teres, sepalis æquilongum vel brevius; *anthera* annularis, 6-locellata, ad marginem connectivi peltatim affixa, rima horizontali dehiscens.—*Fœm. Sepala* 3, cuneato-oblonga. *Petala* 3, subrotunda, subcuneata, carnosula. *Stamina* nulla. *Ovarium* ovatum, gibbum, glabrum, 1-loculare, *ovulo* solitario parieti appenso. *Stylus* subnullus. *Stigma* subsessile, excentricum, inæqualiter 3–6-laciniatum; laciniis acutis, subreflexis. *Drupa* carnosa, glabra; *putamen* osseum, obovatum, valde compressum, 1-loculare, *loculo* peripherico et hippocrepiformi circa condylum voluto, utrinque seriebus 2 concentricis tuberculorum liris sæpe connexis extus armato; *condylus* excentralis, laminiformis, discoideus, utrinque subconcavus, medio foramine distincto perforatus. *Semen* hippocrepiforme, dorso convexum, ventre subplanum; *integumentum* tenuiter membranaceum,

linea longitudinali ad condylum affixum; *embryo* in *albumini* simplici carnoso, hippocrepiformis, tenuiter elongatus, teres, *cotyledonibus* semiteretibus, incumbentibus, *radiculæ* superæ tereti ad stigma spectanti æquilongis et æquilatis.

Frutices *scandentes, in Asia intertropica, in insulis adjacentibus, necnon in Australia et Africa crescentes;* radix *sæpe tuberosus;* caulis *ramosus;* folia *alterna, profunde peltata, suborbicularia, deltoideo-ovata vel oblonga, integra vel sinuato-angulata, imo rotundata, truncata vel cordato-sinuata, palmatinervia, sæpius glabra:* panicula *in utroque sexu supra-axillaris, sæpe longissime pedunculata, umbellatim ramosa;* umbellis *iterumque umbellulatis, multifloris;* flores *minuti, in capitulas dense aggregati, vel laxe corymbulosi.*

The following species will be fully described in the third volume of my 'Contributions to Botany:'—

1. *Stephania longa,* Lour. Coch. ii. 747;—Cocculus Roxburghianus, *Wall. in parte* (*non DC.*);—v. s. in hb. Mus. Brit. ♂, China (Staunton); in hort. bot. Calc. culta (Roxburgh); in hb. Soc. Linn. hort. Calc. cult. (Wall. Cat. 4972, non A, B, C); in hb. Hook., Khasya (Hook. & Th.).
2. —— *Japonica,* nob.;—Cocculus Japonicus, *DC. Syst.* i. 516; *Prodr.* i. 96;—Menispermum Japonicum, *Thunb. Jap.* 195; *Lam. Dict.* iv. 96;—Clypea venosa, *Bl. Bijdr.* 27;—Stephania venosa, *Walp. Rep.* i. 96;—v. s. in hb. variis, ♂ & ♀, ins. Philipp. (Cuming, 1160); in hb. Hook. Kurg, ♂ (Hook. & Th.); ♂, Concan (Law); ♀, Concan (Gibson); pen. Ind. ♂ & ♀ (Wight, 953).
3. —— *glaucescens,* Walp. Rep. i. 96;—Clypea glaucescens, *Dcne. Nouv. Ann. Mus.* iii. 423, t. 18;—Cocculus Japonicus, *var.* Timoriensis, *DC. Prodr.* i. 96;—v. s. in hb. Lindl. ♂, Timor (Dcne).
4. —— *rotunda,* Lour. (non H. & T.) Coch. ii. 747; Hook. & Th. in parte, Fl. Ind. i. 197;—v. s. in hb. Mus. Brit. ♂, China (Loureiro); in hb. Hook. ♂, Kumaon (Thomson, 1227).
5. —— *Roxburghiana,* nob.;—Stephania rotunda, *H. & T. in parte, l. c.* 197;—Cocculus Roxburghianus, *DC. Syst.* i. 516; *Prodr.* i. (*non Willd.*);—Cissampelos hexandra, *Roxb. Fl. Ind.* iii. 841;—Cissampelos Pata, *Buch.* (*non Roxb.*);—Cissampelos Finlaysonianus, *Wall.* (*in parte*);—v. s. in hb. Soc. Linn. ♀, Madras (Wall. Cat. 4977 D), ♂ & ♀, Siam (ibid. 4974 A); ♂, Moulmein (ibid. 4977 H); ♀ (ibid. 1291); in hb. Mus. Brit. ♀, India (Buchanan); in hb. Hook., Bengal (Hook. & Th.), Bunsal (Thwaites).
6. —— *glabra,* nob.;—S. rotunda, *Hook. & Th.* (*in parte*)

l. c. 198;—Cissampelos glabra, *Roxb. Fl. Ind.* iii. 840;—Clypea Wightii, *Arn. in Wight. Ill.* p. 456;—Cocculus Roxburghianus, *Wall. Cat.* (*non DC.*);—Cocculus Finlaysonianus, *Wall.* (*in parte*);—v. s. in hb. Soc. Linn. ♂, Nepal (Wall. Cat. 4972 B); ♀, Molung (ibid. 4972 A, *b*; ib. 4974 B), Sylhet (ib. 4972 C); in hb. Hook., Courtallam (Wight, 2462), Assam (Masters), Vavao (Kay); ♂, Moulmein (Parish), Bhootan, Kumaon (Griffiths, 1731); ♀, Himalaya (Griffiths); ♂, Kumaon (Strachey); ♀, Khasya (Hook. & Th.).

7. *Stephania gracilenta*, nob.;—v. s. in hb. Soc. Linn. ♂, Segain, Prome (Wall. Cat. 4977 A); ♀, Nepal (Wallich); in hb. Hook. ♂, Rangoon (M'Clelland); ♂, Martaban (Scott); in hb. Mus. Brit. et alior. ♂, Nepal (Wallich).

8. —— *glandulifera*, nob.;—Steph. rotunda, *Hook. & Th.* (*non Lour.*) *l. c.* p. 197;—v. s. in hb. Hook. ♂, Khasya (Hook. & Th.); ♀, Sikhim, Khasya (Hook. & Th.).

9. —— *appendiculata*, nob.;—v. s. in hb. meo et Hook. ♀, Nielgherries (Gardner).

10. —— *intertexta*, nob.;—v. s. in hb. Hook. ♂ & ♀, Ceylon (Walker), ibid. (Gardner, 32), Kandy (Thwaites, 2757).

11. —— *hernandifolia*, Walp. Rep. i. 96; Hook. & Th. (in parte) Fl. Ind. i. 196;—Clypea hernandifolia, *Wight. Icon.* tab. 939;—v. s. in hb. Soc. Linn. ♂, Nepal (Wall. Cat. 4977 K), Sylhet (ib. 4977 F); ♂, Segain (Wallich), Goyalpoor, ♂ & ♀ (Wall. Cat. 4977 A, *a*, 4977 B, *b*); in hb. Mus. Brit., Assam (Griffiths, 572); in hb. Hook. ♂ & ♀, Assam (Griffiths, 356, 357), Mergui (Griffiths, 823), Concan (Javin).

12. —— *discolor*, Walp. Rep. i. 96;—Clypea discolor, *Bl. Bijd.* 26;—v. s. in hb. plurim. ♂, Java (Zollinger, 462); in hb. Mus. Brit. ♀, Java (Horsfield, 472); in hb. Hook. ♂ & ♀, Java (Spanaghoe).

13. —— *latifolia*, nob.;—v. s. in hb. Hook. ♂, Mucklow, Khasya (Hook. & Th.).

14. —— *Gaudichaudii*, A. Gray, Bot. Wilkes Exped. i. 37;—v. s. in hb. DC. ♂, Port Jackson (Gaudichaud, 34).

15. —— *obvia*, nob.;—v. s. in hb. Hook., Java (Horsfield, 684).

16. —— *concinna*, nob.;—v. s. in hb. Mus. Brit. et Hook. ♂ & ♀, Java (Horsfield).

17. —— *hypoglauca*, nob.;—v. s. in hb. Soc. Linn., Nielgherry, ♀ (Wall. Cat. 4982 A, *a*, non A, *b*) (Noton).

18. —— *elegans*, Hook. & Th. Fl. Ind. i. 195;—v. s. in hb. Mus. Brit. et Soc. Linn. ♀, Nepal (Wallich); in hb. Hook. ♂ & ♀, Khasya et Sikhim (Hook. & Th.); ♂, Darjeeling et Khasya (Griffiths, 581); ♂, Assam (Jenkins); ♂ & ♀, Gurwhal (Falconer, 89); ♀, Mucklow (Hook. & Th.).

19. *Stephania exigua*, nob.;—v. s. in hb. variis, ♂, ins. Philipp. (Cuming, 1533).
20. —— *Australis*, nob., in Ann. Nat. Hist. vii. 40; A. Gray in Bot. Wilkes Exp. p. 38;—Stephania hernandiifolia, *Hook. & Th.* (*in parte*) *l. c.* p. 196;—Stephania Hookeri, *F. Mueller, MS.*;—v. s. in hb. Heward, ♀, Sydney (A. Cunningham); in hb. Hook. ♂, Hastings River (Burke); ♀, Burnett River (Mueller), Brisbane River.
21. —— *pallidula*, nob.;—v. s. in hb. Hook., Australia, Fitzroy Range (Mueller).
22. —— *prælata*, nob.;—v. s. in hb. Lindley ♂ & ♀, Africa austr. (Cooper, 904).
23. —— *lævigata*, nob.;—v. s. in hb. Hook. ♂, Fernando Po (Mann, 629).
24. —— *fastosa*, nob.;—v. s. in hb. Hook. ♂, Camaroon Mt. (Mann, 2169).
25. —— *bullulata*, nob.;—v. s. in hb. Hook. ♂, Camaroon Mt. (Mann, 1342).
26. —— *ramuliflora*, nob.;—v. s. in hb. Hook. ♂, Borneo (Motley, 1103).

30. Clambus.

This genus was founded by me, more than twelve years ago, upon a Mexican plant, collected by Ruiz and Pavon, its general characters being sketched, two years since, in my synopsis (huj. op. xiii. p. 123). It belongs to the *Cissampelideæ*, and differs from *Cissampelos* in its very different habit, its inflorescence, and the presence of six sepals and six scale-like petals in the male flower: in this latter respect it approaches *Pericampylus* and *Pselium*; but its anthers are combined in a peltate disk supported on a slender filament, as in *Cissampelos*. It offers some analogy towards *Stephania*; it has the same number of sepals, but double the number of petals, a different kind of inflorescence, and a dissimilar habit. The female plant is unknown. The genus differs from all others of the *Cissampelideæ* in its leaves not being peltate, and therefore not palmatinerved, the nerves being all imparipinnate as we find them in *Pycnarrhena*, *Penianthus*, and some species of *Hypserpa*: the leaves are supported upon very short petioles, and are ovate or elliptic, with about eight pairs of alternately diverging nerves; they are very reticulated above, glabrous on both sides, but opakely white beneath: this cretaceous appearance, when viewed under a lens, is found to consist of a prominent network of white and extremely minute crossing fibres, like a spider's web, which fills the areoles of the ordinary venous reticulations. The inflorescence is axillary, upon an elongated, very slender rachis longer

than the leaf; its alternate branches, bracteolated at base, are dichotomously divided, the branches bearing many alternate pedicels, bracteolated at base, and spicately arranged.

Clambus, nob.;—*Flores* dioici. *Masc. Sepala* 6, biseriata, subæqualia, alternatim paululo angustiora, oblonga, petaloidea, nervo longitudinali signata, patentia, æstivatione imbricata. *Petala* 6, subbiseriata, æqualia, sepalis dimidio breviora, lineari-oblonga, apice emarginata, crasso-carnosa. *Stamen* unicum, centrale; *filamentum* tenue, sepalis paulo brevius; *anthera* peltata, 3-locularis, annuliformis, circa *connectivum* peltiforme affixa, loculis emarginatis, transversim bilocellatis, extus horizontaliter 2-valvatim dehiscentibus.—*Fl. fœm.* et *fructus* ignoti.

Frutex *Mexicanus, forsan volubilis, glaberrimis;* folia *alterna, palata, late ovata vel elliptica, nitida, subtus incana, pinnatonervosa, breviter petiolata:* panicula ♂ *axillaris, glaberrima, gracilis, folio longior, bracteolata, mox ramosa, ramis longiusculis, ramulis spicatim plurifloris;* flores *minuti, brevissime pedicellati.*

The single species, *Clambus araneosus,* will be described in the third volume of the 'Contributions to Botany.'

31. Cyclea.

This genus, established by Dr. Arnott, was confounded with *Clypea* and *Stephania,* until I first pointed out the lines of demarcation between them. It is easily distinguished from them by its habit, another kind of inflorescence, by having a gamosepalous calyx, a turbinately campanular corolla, both of them often toothed or cut into deeply laciniated segments, and by having a very different putamen. The authors of the 'Flora Indica,' in acknowledging the validity of *Cyclea,* rightly united my genus *Rhaptomeris* with it: in the former the calyx and corolla are tubular, with a four- or five-toothed border; in the latter the segments are deeper; so that the difference is only one of degree, and is consequently of specific rather than of generic value. A casual observer may be misled in regard to the number of floral parts in the female flower; for in examining a capitate head of flowers, a number of persistent scales, varying from four to twelve, may be seen sometimes surrounding an ovary; but these extra scales really belong to other abortive flowers congregated on the same receptacle. The learned botanists, in their work above mentioned (p. 200), describe the female flower of *Cyclea* as having two sepals laterally placed about a solitary ovary, without any petal; but this does not correspond with my

observations: in the very numerous flowers I have examined I have never yet found a sepal unaccompanied by a petal, which is of nearly equal size, seated upon its claw, the former being always recognizable by its external pubescence, while the latter is invariably more fleshy and perfectly glabrous. This fact is reduced to a certainty in *C. peltata*, where the inflorescence is more spread, each flower being supported by a pedicel of equal length, bracteated at its base; we there find constantly a single sepal, with its corresponding petal, both placed on that side of the ovary which regards the axis of inflorescence. In *C. Arnottii* and in *C. versicolor*, where the ultimate ramifications of the racemes are extremely abbreviated, and on which two or more sessile flowers are closely aggregated, they are sometimes constituted as in the case last mentioned, but very often we see as many as three or four sepals with their corresponding petals around a single persistent ovary, where the other corresponding ovaries have disappeared: in such case there can be no doubt that this increased number of floral parts is due entirely to the decadence or abortion of the ovaries, which often fall out of a head of flowers while under examination. We may therefore consider that normally each female flower of *Cyclea* consists of one sepal, one petal, and one ovary, as in *Cissampelos*, with this difference, that in the former the sepal and petal are antical, while in the latter they are postical. The putamen of *Cyclea* is smaller than that of *Stephania*, and more globular; its condyle is not disciform, but is expanded into a large hollow chamber, convex exteriorly on both sides, around which the somewhat hippocrepical cell is circumscribed; the embryo is like that of *Cissampelos*, with its cotyledons somewhat shorter.

Cyclea, Arnott.—*Flores* dioici. *Masc. Calyx* gamosepalus, tubulosus; tubus aut late campanulatus ore 4–5-dentatus, vel turbinatus et profundius in lacinias totidem oblongas fissus, æstivatione valvata. *Corolla* campanulata, calyce dimidio brevior, in lacinias 4–5 plus minusve profundas fissa, laciniis integris, truncatis aut crenulatis, glabra. *Stamen* unicum; *filamentum* centrale, tenue, teres, petalo æquilongum; *anthera* peltata vel peltatim globosa, 4–6-locellata, loculis circa connectivum sæpe minusculum adnatis, extus rima horizontali hiantibus et singulis septo horizontaliter 2-locellatis.—*Fœm. Sepalum* unicum, oblongum, squamiforme, extus pilosum. *Petalum* unicum, dimidio brevius, orbiculare, carnosum, glabrum, ad unguem sepali affixum. *Ovarium* solitarium, gibboso-globosum, villosum, 1-loculare, 1-ovulatum. *Stylus* brevis, subexcentricus. *Stigmata* 3, subulata, acutissima, suberecta. *Drupa* ovata, carnosa, sæpius hirsuta, stigmate per-

sistente basi proximo notata; *putamen* subosseum, globoso-ovale, paululo compressum, 1-loculare, loculo circa condylum hippocrepice gyrato; *condylus* excentralis, subglobosus, utrinque convexus, vacuus, in sinu basali pro vasorum introitu pertusus. *Semen* loculo conforme; *embryo* intra *albumen* simplex, hippocrepicus, tenuiter teres, *cotyledonibus* semiteretibus, incumbentibus, *radicula* supera ad stylum spectante 3-plo longioribus.

Frutices *scandentes Asiæ intertropicæ, sæpius pubescentes aut retrorsum hispidi*; folia *alterna, peltata, deltoideo-oblonga aut obovata, subcordata, 5–7-nervia,* petiolo *tenui*: inflorescentia ♂ *axillaris, aut* racemus *elongatus,* rachi *tenui, sæpe geniculatim flexuosa,* floribus *numerosis minutis in glomerulos remotos aggregatis*; *aut in utroque sexu* panicula *racemosa, ramis alternis, remotis, longiusculis, sæpe iterum ramosis, floribus corymbulosis aut agglomeratis.*

Copious descriptions of all the following species will be given in the third volume of my 'Contributions to Botany':—

1. *Cyclea peltata,* Hook. & Th. (in parte) Fl. Ind. i. 201;—Menispermum peltatum, *Lam.*;—Cocculus peltatus, *DC.*;—v. s. in hb. Soc. Linn. ♂ & ♀, Sylhet (Wall. Cat. 4978 c), Prome (Wallich); in hb. Hook. ♂ & ♀, Java (Spanaghoe, 194); ♂, Assam (Griffiths, 355).
2. —— *barbata,* nob.;—Cissampelos barbata, *Wall.* (*in parte*), Rangoon (Wall. Cat. 4978 A, *a*), Taong Dong (Wall. Cat. 4978 E).
3. —— *Arnottii,* nob.;—Cyclea Burmanni, *Wight, Ill.* i. 22 (in parte);—C. Burmanni, *Hook. & Th. l. c.* 201 (*in parte*); Clypea Burmanni, *W. & A. Prodr.* i. 14 (*in parte*);—v. s. in hb. Soc. Linn. ♂, Kelaben (Wall. Cat. 4978 A, *b*); Singapore (Wall. Cat. 4978); ♀, Prome (Wall. Cat. 4978 B); in hb. Hook. ♀, Rangoon (M'Clelland); ♀, Kurg (Hook. & Th.); ♂, Khasya (Hook. & Th.); ○, Mangalore (Ward); ♀, Ind. or. (Walker).
4. —— *Burmanni,* Hook. & Th. *l. c.* 201;—Rhaptomeris Burmanni, *nob. olim*;—Clypea Burmanni, *W. & A. Prodr.* i. 14 (*in parte*);—Cocculus Burmanni, *DC. Syst.* i. 517;—v. s. in hb. Mus. Brit., Ceylon (Hermann); in hb. Hook. ♂, Ceylon (Walker, 194); ♀, Ceylon (Gardner, 33), Ceylon (Thwaites, 1049); ♂, Kandy (Champion); Ind. Penins. (Wight, 40); ♂, Concan (Stocks, Gibson, Law).
5. —— *versicolor,* nob.;—Cyclea peltata, *Hook. & Th.* (*in parte*) *l. c.* 201;—Cissampelos discolor, *Wall.* (*in parte*);—v. s. in hb. Soc. Linn. ♂, Nielgherries (Wall. Cat. 4982 B); ♀, Trevandrum (Wall. Cat. 4982 A, *b*, non A, *a*).

6. *Cyclea laxiflora*, nob.;—v. s. in hb. Hook. ♂ & ♀, Malacca (Griffiths).
7. —— *peregrina*, nob.;—v. s. in hb. Hook. ♂ & ♀, Borneo (Mottley, 673 & 684).
8. —— *debiliflora*, nob.;—v. s. in hb. Hook. ♂, Khasya (Hook. & Th.).
9. —— *pendulina*, nob.;—v. s. in hb. Mus. Brit. ♂ & ♀, Nicobar Isl. (Soc. Fratr.).
10. —— *deltoidea*, nob.;—v. s. in hb. Hook., Hong-Kong (Champion).

32. Peraphora.

This genus was first proposed by me for a plant originally collected in Bhootan by Griffiths, which had female flowers and fruit only. Since then I found that the *Cyclea populifolia* described by Messrs. Hooker and Thomson is the male plant of the same species. It differs from *Cyclea* in its habit, its large, coriaceous, cordate leaves on a rigid petiole almost palately inserted, its different mode of inflorescence, in its floral structure, and in its putamen. Although the male flower has a campanular calyx, it has no petal; the female flower has two comparatively large, opposite, sacciform, fleshy sepals, and no petal, and its putamen bears no resemblance to that of *Cyclea*. It is thus certain that, with the exception of a campanular calyx in the ♂ flower, the floral structure in both sexes is totally at variance with the characters of the genus to which it has been referred by the authors of the 'Flora Indica.' In the number of calycine parts it accords with *Antizoma*; but it differs in having no petals, and in the gamosepalous calyx of its ♂ flower: these differences, together with the very dissimilar habits of the plants, will maintain the validity of both these genera. The putamen, in its shape and its curved spines, resembles that of some species of *Stephania*, but it differs in having an imperforated condyle.

The generic name was suggested by the singularly bursiform sepals of the female flower.

Peraphora, nob.;—Cyclea (*in parte*), *Hook. & Th.*;—*Flores* dioici. *Masc. Calyx* globoso-campanulatus, ore parvo, 4–5-dentato, glaber, carnosulus. *Petalum* nullum. *Stamen* unicum, centrale, subinclusum; *filamentum* breviter filiforme; *anthera* subglobosa, 4–5-locularis, loculis circa connectivum peltatum in annulum connatis, margine rima externa horizontaliter dehiscentibus.—*Fœm. Sepala* 2, opposita, pro mole majuscula, suborbiculata, valde concava, imo gibboso-saccata, ungue brevi affixa, carnosa, lateribus tenuioribus et expansis, apice truncato et subreflexo. *Petala* nulla. *Stamina* nulla.

Ovarium solitarium, gibboso-orbiculare, 1-loculare, loculo lunato; *ovulum* unicum, loculo conforme, funiculo brevi e medio faciei ventralis appensum. *Stylus* brevis. *Stigma* breviter 3-fidum, laciniis linearibus, sulcatis, reflexis. *Drupa* subglobosa, stigmate persistente ad hilum proximo notata, carnosa; *putamen* tenuiter osseum, late subovatum, compressum, peripheriam versus utrinque spinis obtusis recurvo-hamatis in seriebus 3 circa condylum hippocrepicis concentrice dispositis echinatum, 1-loculare, loculo lunato; *condylus* disciformis, excentralis, utrinque concavus, imperforatus, medio stria longitudinali sulcatus; *semen* loculo conforme; *embryo* ignotus.

Frutex *in regionibus Himalayæ scandens*; folia *majuscula, vix peltata, oblonga, imo cordata, a medio sensim angustiora, apice acuta, e basi 7-nervia, coriacea, subtus pubescentia,* petiolo *tereti, limbo breviore:* inflorescentia ♂ *et* ♀ *racemiformi, paniculata, pubescens, ramis alternis, divaricatis, iterum divisis, bracteolatis;* flores *minimi, pedicellati, glabri.*

The single species will be described in the third volume of my 'Contributions to Botany':—

1. *Peraphora robusta,* nob.;—Cyclea populifolia, *H. & Th. Fl. Ind.* i. 202;—Menispermea, *Griffiths in Itin. Bootan,* ii. 114 & 165; *Icon. Boot.* tab. 22 & 23;—v. s. in hb. Mus. Brit. et Lemann, ♀, Bhootan (Griffiths, 1732); in hb. Hook. ♂ & ♀, Sikhim (Hook. & Th.), Bhootan (Griffiths, 1732).

33. Perichasma.

I propose this genus for a plant, belonging to the tropical African Flora, which offers many peculiar characters. Although the number of its floral parts corresponds with that of *Stephania,* the entire aspect of the plant proclaims that it cannot belong to that genus, as does that of *Clambus* for a similar reason. Its slender branches, with very distant axils, are furnished with long, patent, simple hairs, which I have never seen in any species of *Stephania*; its leaves are larger, and, though peltate, are pilose on both sides, and their margins are furnished with a strong marginal nerve, which is indented into several rounded lobes or large crenatures, and they are supported upon unusually long and slender petioles. The inflorescence, instead of being, as in *Stephania,* a compound umbel rarely exceeding an inch or two in length, is here a very slender pendent raceme a foot and a half long, with numerous distant, short, alternate branches, which are again and again alternately divided: in all these respects the general habit of the plant is more in harmony with some species of *Cyclea.* The flowers are very minute, pedicellated, with six oblong, subacute

sepals in two series, imbricated in æstivation, three small, ovate, erect petals, and a central stamen almost concealed by the petals. It is, however, in the structure of the stamen that this genus differs essentially from *Stephania*: in the latter genus the anther has three or six cells, connate in an annular ring, affixed on the margin of a peltate disciform connective, which is supported on the central filament; these cells always burst bivalvately by a crenated horizontal line of sutures. In *Perichasma* the anther has no connective, is comparatively large, completely globular, simply 1-celled, and dehisces by a somewhat small apical opercular valve, which is supported by a columella-like extension of the filament (or *placentoid* of M. Chatin), round which the grains of pollen are secreted; the wall of the globular cell consists of a finely reticulated membrane (apparently deficient of the usual inner lining or endothecium), is very delicate in texture, without the slightest vestige of any dissepiment or nervure, its three indented furrows being due to the external pressure of the petals which embrace it in the bud. This organization of the anther is without any parallel in the *Menispermaceæ*, and reminds us of the opercular theca of some of the mosses.

The generic name is derived from *περὶ*, *circum*, *circa*, *χάσμα*, *hiatus*, in allusion to the feature just mentioned. I have placed it among the *Cissampelideæ*, but I am not certain that this is its proper place.

Perichasma, nob.—*Flores* dioici. *Masc. Sepala* 6, biserialia, quorum 3 interiora paululo longiora, oblonga, submembranacea, demum expansa. *Petala* 3, dimidio breviora, orbicularia, carnosula, margine membranacea, erecta, sepalis exterioribus opposita. *Stamen* unicum, centrale; *filamentum* tenue, petalis brevius; *anthera* majuscula, globosa, leviter 3-sulcata, apicifixa, septorum nullo vestigio omnino 1-locularis, theca tenuiter membranacea et minutissime reticulata, supra medium rima horizontali operculatim dehiscente, operculo parvo, apicali, columella centrali suffulto; *pollen* simplex.—*Fœm.* ignoti.

Frutex *scandens Africæ tropicæ;* rami *longe pilosi;* folia *alterna, peltata, oblonga, imo truncata, palmati-nervia, margine grosse crenata, sparse pilosa, longe et tenuiter petiolata:* inflorescentia *♂ supra-axillaris, longissime racemiformis, pendula,* pedunculo *tenuissimo, puberulo, alternatim ramoso,* ramis *iterumque ramosis,* ramulis *plurifloris;* floribus *minutis, alternis, pedicellatis, glabris.*

The single species, *Perichasma lætificata*, will be described in the third volume of the 'Contributions to Botany.'

[To be continued.]

V.—*Notulæ Lichenologicæ.* No. VII.

By the Rev. W. A. Leighton, B.A., F.L.S.

In the 'Flora' (1865, p. 260) Dr. Wm. Nylander describes three European species of *Thelocarpon.*

1. *Thelocarpon Laureri* (Flot.).

Apothecia globulos formantia (diam. 0·12–0·15 millim.) citrino suffusos. Thecæ myriosporæ fusiformes; sporæ incolores, oblongæ, simplices (longit. 0·0025–0·0040 millim., crassit. 0·0015–0·002 millim.); paraphyses graciles sat parcæ et nonnihil irregulares. Gelatina hymenea iodo vix tincta, sed thecæ dilutissime cærulescentes.

Vidi specimen in Anglia lectum a Rev. Leighton (1864).

Sporæ utroque apice obtusiores quam in figuris a Rev. Leighton datis. Paraphyses (crass. 0·0015 millim.) intus guttulas oleosas efferentes, sæpe ramoso-divisæ.

2. *Thelocarpon intermediellum,* Nyl.

Extus simile præcedenti, sed globuli paullo majores (diam. 0·2 millim.). Thecæ myriosporæ; sporæ oblongæ (longit. 0·0035–0·0050 millim., crass. 0·0020 millim.), vulgo medio obsolete tenuiores et utroque apice obtuse incrassatulæ; paraphyses nullæ. Gelatina hymenea iodo vinose fulvescens; thecæ dilute cærulescentes.

Ad lignum alni putrescens in Finlandia media (Norrlin) [1863].

A præcedente differt magnitudine paullo majore, sporis aliis et defectu paraphysium. Adsunt filamenta ostiolaria brevia, gracilia, fasciculata in supera parte cavitatis perithecii (omnino sterigmata simulantia spermogonii).

3. *Thelocarpon superellum,* Nyl.

Subsimile binis præcedentibus quoad faciem externam, at globulis nonnihil majoribus (diam. 0·25 millim.). Thecæ polysporæ; sporæ ellipsoideæ (longit. 0·009–0·012 millim., crassit. circiter 0·0045 millim.); paraphyses graciles, elongatæ, rectæ. Gelatina hymenea iodo non tincta, sed thecæ totæ bene cærulescentes.

Kola, in Lapponia orientali, ad lignum vetustum (N. I. Fellman) [1863].

Notis allatis, sporis multo majoribus, paraphysibus &c. facillime dignotum.

Dr. Nylander inclines to think that our English *Thelocarpon Laureri,* described and figured by me in 'Annals and Mag. Nat.

Hist.' Dec. 1864, t. 9. f. 1–5, may be possibly different from the typical *Th. Laureri*, Flot. Should this prove to be the case, the name he proposes, *Th. anglicum*, must be adopted for the English plant, limiting *T. Laureri* to the German specimens. Dr. Körber, to whom I forwarded a specimen, compared it with his authentic specimen (but whether microscopically or merely externally, I know not), and thought them identical. Dr. Nylander has kindly afforded me an opportunity of examining his *Th. intermediellum*, which corresponds with the characters he has given of it. Recurring to my own specimens, I am disposed to think that the plant found by me parasitically on *Bæomyces rufus* (see Ann. *l. c.*) will eventually prove to be another species (for which I would propose the name *Thelocarpon epithallinum*). In it I find the paraphyses to be stronger, unbranched, and shorter than in others, the asci more elongated, lineari-cylindrical, and the spores (which I could not disengage from the asci, and therefore may be optically deceived by the appearance of their close approximation or packing) to be of an irregular spherical shape. There also appears a difference in the gonidia. But the plant was in too unsatisfactory a state to determine this decisively.

VI.—*Fifth Account of new Species of Snakes in the Collection of the British Museum.* By Albert Günther, M.A., M.D., Ph.D.

[Plates VI. & VII.]

The following species of Ophidians have been added to the Collection of the British Museum since the publication of the last paper on the same subject in this Journal (February 1865, p. 89). The total number of species in that collection amounts now to 827, and that of the typical specimens to 303. Our numerous specimens of Typhlopides have been examined by Prof. Peters, who has been for some years engaged upon a monograph of this family.

In the following lists some of the species are marked with an asterisk (*): they will be described in this paper.

I. *List of Species which were formerly desiderata.*

Helminthophis flavoterminatus, *Ptrs.* Caraccas. Purchased.
—— albirostris, *Ptrs.* Guayaquil. Mr. Fraser.
Typhlops tenuis, *Jan.* Bengal. Purchased.
—— lineolatus, *Jan.* ——?
—— Mülleri, *Schleg.* (=*Pilidium dimidiatum*, Blkr.). East-Indian archipelago. Dr. Bleeker.
—— polygrammicus, *Schleg.* New South Wales. G. Krefft, Esq.

Onychocephalus Kraussii, *Jan.* Old Calabar and Fernando Po. Purchased.
—— lalandii, *Schleg.* Cape of Good Hope. Purchased.
—— Bibronii, *Smith.* Cape of Good Hope. Sir A. Smith. (Typical specimen.)
—— verticalis, *Smith.* Cape of Good Hope. Sir A. Smith. (Typical specimen.)
—— capensis, *Smith.* Cape of Good Hope. Sir A. Smith. (Typical specimens.)
—— mucruso, *Ptrs.* Zambesi Expedition.
—— mossambicus, *Ptrs.* Mozambique. Purchased.
Stenostoma cairi, *D. & B.* Thebes. Prof. Peters.
—— macrolepis, *Ptrs.* Mexico. Purchased.
—— macrorhynchum, *Jan.* Euphrates Expedition.
—— bilineatum, *D. & B.* Martinique. Purchased.
—— nigricans, *Smith.* South Africa. Sir A. Smith. (Typical specimens.)
—— fallax, *Ptrs.* Peru. Prof. Nation.
*Calamelaps unicolor, *Rnhrdt.* Sierra Leone. Purchased.
Rhabdion torquatum, *D. & B.* Borneo. Prof. Peters.
Hapsidophrys cæruleus, *Fischer.* Sierra Leone. Purchased.
Rhagerrhis producta, *Ptrs.* Nubia. Prof. Peters.
—— multimaculata = Coronella multim., *Smith* = Dipsina multim., *Jan.* Damara Land. Purchased.
*Atractaspis corpulentus, *Hallow.* ——? St. G. Mivart, Esq.
Trimeresurus mucrosquamatus, *Cantor.* Formosa. Consul R. Swinhoe.
Echidna inornata, *Smith.* South Africa. Sir A. Smith. (Type of the species.)

II. *List of the new Species procured and described in the course of the year* 1865.

Typhlops obtusus, *Ptrs.* Shiré Valley. Zambesi Expedition.
—— Güntheri, *Ptrs.* North Australia. Mr. Elsey.
Stenostoma scutifrons, *Ptrs.* Benguela. Mr. Monteiro.
*Calamaria arcticeps. Borneo. L. L. Dillwyn, Esq.
*Ablabes flaviceps. East-Indian archipelago. Purchased.
*Zamenis brachyurus. Dekkan. Purchased.
*Herpetæthiops Bellii. Sierra Leone. Lieut. Bell.
*Ahætulla nigromarginata. Upper Amazons. Mr. Bartlett, junr.
*Aspidiotes melanocephalus, *Krefft.* ——. G. Krefft, Esq.
Hoplocephalus mastersii, *Krefft.* Flinders Range. G. Krefft, Esq.
*Atractaspis microlepidota. West Africa? A. Günther.

Calamaria arcticeps. Pl. VI. fig. C.

Body moderately slender; tail short; head narrow, elongate, the frontals being longer than broad, as long as the vertical. Vertical five-sided, broader posteriorly than anteriorly, the lateral edges being slightly convergent towards the front.

Five upper labials, the third and fourth below the orbit; the first pair of lower labials touch each other behind the mentale, without forming a suture. No azygos shield between the chin-shields. Ventrals 151; anal entire; subcaudals 16. Brownish above, with eight brown longitudinal lines—two along the median line of the back (that is, one on each side of the vertebral series of scales), a broader one along the meeting edges of the fourth and fifth outer series of scales, one of the same width along the meeting edges of the second and third series, and, finally, one, very narrow, along the meeting edges of the two outermost series. A broad brown collar on the neck, edged with yellowish; tail with two large black transverse spots. Lower parts uniform yellowish.

Eight inches long. Borneo.

Calamelaps, gen. nov.

Body cylindrical, rather slender; tail short in the female, of moderate length in the male. Two pairs of frontal shields; rostral rounded, moderate; nasal single, its anterior portion pierced by the nostrils; loreal and anteorbital absent, the posterior frontal forming a broad suture with the third labial; postórbital minute or absent; the fifth labial forming a long suture with the occipital; six upper labials. Eye very small. Scales smooth, without apical groove, in seventeen rows; anal bifid; subcaudals two-rowed. The posterior maxillary tooth elongate and grooved.

The type of this genus is *Calamaria unicolor* (Rnhrdt.), from West Africa.

Ablabes (*Enicognathus*) *flaviceps*. Pl. VI. fig. B.

Habit rather slender; head depressed, with very short snout. Scales in seventeen rows. Loreal rather higher than long; one præocular, just reaching the upper surface of the head; two postoculars. The occipital extends downwards to the lower postocular; temporals 2 + 2, the two anterior in contact with the lower postocular. Eight upper labials, the third, fourth, and fifth entering the orbit. Anterior chin-shields not longer, but rather broader than the posterior, and in contact with four lower labials. Ventrals 150; anal bifid; subcaudals 97. Maxillary teeth small, numerous, closely set. Upper parts brownish black, powdered with grey. A grey band commences on the neck, runs along each side of the back, where it is three scales broad, and disappears on the tail; anteriorly it is edged with black, in the middle accompanied with black spots along the edges; posteriorly the black spots stand in regular intervals within the band. Head and anterior part of the nape dark

yellow; a straight, blackish longitudinal streak runs through the eye. Lower parts yellow; each ventral with a black spot on each side.

East-Indian archipelago. 20 inches long; tail 7 inches.

Zamenis brachyurus. Pl. VI. figs. A, A′.

This species resembles in general habit a small *Dromicus*. Rostral shield scarcely broader than high, extending to the upper surface of the snout; anterior frontals half as large as the posterior. Vertical of moderate size, five-sided, rather shorter than the occipitals, which are rounded behind. Loreal as high as long; one præocular, large, extending to the vertical; two postoculars. Upper labials eight, the fourth and fifth entering the orbit; temporals $2+2+3$. Scales elongate, narrow, in twenty-three series. Ventrals 225; anal entire; subcaudals 46; ventrals rounded, not keeled. Eye rather small, with round pupil. The last maxillary tooth is the largest, and separated from the others by an interspace. Upper parts brownish olive; the upper side of the head and the anterior part of the trunk are irregularly spotted with brown, the brown spots being arranged in longitudinal series, and narrowly edged with yellow. The posterior part of the trunk is immaculate. Anterior ventral shields brownish, each with a yellowish posterior edge; posterior ventral shields uniform whitish.

We have obtained a single example from Poonah (Dekkan); it is 17 inches long, the head measuring 7 lines, and the tail 2 inches.

HERPETÆTHIOPS (gen. nov. Dryadid.).

Body and tail slender, scarcely compressed; trunk with about 150 ventral shields, which are keeled; head somewhat elongate, rounded in front, flat above; eye of moderate size, with round pupil; nostril lateral, between shields. Plates of the head regular; loreal present; one anterior and two posterior oculars. Scales rather elongate, smooth, without apical groove, in fifteen rows; ventrals strongly bent up the sides; anal entire. The two posterior maxillary teeth are the longest, not grooved, separated from each other and from the preceding ones by a short interspace.

Herpetæthiops Bellii. Pl. VII. fig. B.

Head rather narrow, distinct from neck. Rostral shield scarcely broader than high, reaching the upper surface of the snout; anterior frontals half as large as the posterior, about as long as broad. Vertical bell-shaped, as large as a superciliary, and not much shorter than the occipitals, which are short and rounded behind. Loreal quadrangular, much longer than deep;

one præocular, nearly reaching the vertical; two postoculars; nine upper labials, the fourth, fifth, and sixth of which enter the orbit. Temporals 2+2, the two anterior being in contact with the postoculars. Scales much imbricate. Ventrals 159; anal entire; subcaudals 85. Deep black above and below; only the lower side of the head and the thirty anterior ventral shields are whitish.

We have received one example only, in a collection made by Lieut. Bell at Sierra Leone; it is 33 inches long, the tail measuring 9 inches.

Ahætulla nigromarginata.

Scales in fifteen rows, slightly keeled. Head small, depressed, with the snout of moderate length, subtruncate in front; rostral shield rather broader than high; loreal none; præorbital not reaching the vertical; two postorbitals; nine upper labials, the fifth and sixth of which enter the orbit; temporals large, 1+2; occipitals rounded, with some larger rounded scales behind. Six lower labials are in contact with the chin-shields. Eye rather large, with round pupil. Body and tail slender and compressed. Ventral shields 158, slightly keeled; anal bifid; subcaudals 115. Maxillary with a cluster of three or four enlarged teeth, which are not grooved and not separated from the others by an interspace. Upper parts green; each head-shield and scale with a black margin; sides without band. Lower parts uniform greenish.

This species would enter the subgenus *Uromacer* of Duméril and Bibron.

The British Museum possesses one example of this species, collected by Mr. Bartlett, junr., on the Upper Amazons; it is a female, 30 inches long, the tail measuring 10.

Ferania Sieboldii, Schleg.

This species attains to a very large size: we have received from the late Sir R. Schomburgk a specimen 46 inches long, the tail measuring 6 inches; the circumference of the middle of its body is 5½ inches. The spots which are so very distinct in the young are confluent, giving a coarsely reticulated appearance to the back. Lower part of the sides and belly with black cross bands placed at regular intervals. Upperside of the head immaculate; a black band from the eye along the temple. This specimen, which is from Siam, has 106 ventral shields only, and the anterior frontals are confluent into one, so that the specimen might be taken for a *Hypsirhina*. However, an original division of the plate is still indicated by an incomplete suture. The *Hypsirhina Bocourti*, noticed by Jan as a new species, is probably not distinct.

Lycophidium Horstockii. Pl. VII. fig. A.

I have mentioned, in 'Colubr. Snak.' p. 197, that large specimens about 2 feet long appear nearly uniformly black, a small number of scales on the posterior part of the body retaining bluish-white edges.

We have received a very singular variety from the Gambia, through the kindness of Sir Andrew Smith: one of the specimens is 21 inches long, and the other about half that size. This is black, nearly all the scales having bluish-white edges. A series of thirty quadrangular white spots occupies the back of the trunk, each spot enclosing nine or ten scales. The series commences with a white longitudinal streak on the neck and occiput, and terminates with about seven streak-like spots on the back of the tail.

This extraordinary variety might be taken as a distinct species; but there is not the slightest structural difference from the typical *L. Horstockii.*

Aspidiotes melanocephalus, Krefft.

Mr. Krefft has kindly sent to the British Museum a fine large specimen of this snake. I could not discover any teeth on the maxillary bone; so that Mr. Krefft appears to be justified at present in placing this snake among the *Boidæ.* However, there is in other points such a strong similarity to *Liasis,* that I cannot help thinking that an examination of younger examples of 2 or 3 feet in length may reveal the presence of those teeth.

Atractaspis microlepidota. Pl. VII. fig. C.

Uniform blackish brown. Body stout. Ventrals 212; subcaudals simple, 26. Scales in twenty-nine series. Two pairs of frontal shields; one præ- and one postocular; six upper labials, the third and fourth entering the orbit; temporals rather numerous and irregular.

This is probably a West African species. Our specimen is 20 inches long, the tail measuring 18 lines.

Atractaspis corpulentus.

According to Hallowell's notes (Proc. Acad. Nat. Sc. Philad. 1857, p. 70), his specimen had one pair of frontals and 182 ventral shields; our specimen differs in having two pairs of frontals and 210 ventral shields. However, we have seen similar variations in one and the same species of African snakes, and would not regard the two specimens as specifically distinct, without further proof.

The British Museum now possesses four very distinct species of this genus, so characteristic of the western and southern parts of Africa.

VII.—*Remarks on some Fishes from the River Amazons in the British Museum.* By Dr. Albert Günther.

A collection of fishes made by Mr. Bartlett, junr., on the Upper Amazons, and acquired for the British Museum, contained, besides numerous examples of described species, a few which appear to be new to science*. It afforded me also the opportunity of comparing the true *Prochilodus nigricans* of Agassiz with its congener from the Essequibo River (cfr. Fish. v. p. 295). They prove to be specifically distinct, the species from the Amazons having somewhat smaller scales, viz. L. lat. 48. L. transv. 10/9. The height of the body is one-third of the total length (without caudal). The name *nigricans* must be retained for the Amazons species, whilst the Essequibo fish is most probably identical with *P. rubrotæniatus* (Schomb.).

Tetragonopterus Bartlettii, n. sp.

D. 11. A. 31. L. lat. 39. L. transv. 8/7.

The height of the body is contained twice and three-fourths in the total length (without caudal), the length of the head thrice and two-thirds. Interorbital space convex, its width being scarcely more than the diameter of the eye, which is one-third of the length of the head. The upper profile of the head is very slightly concave. The maxillary extends a little behind the vertical from the front margin of the orbit. The origin of the dorsal fin is immediately behind the base of the ventrals. Pectoral extending beyond the base of the ventrals, nearly to the vertical from the origin of the dorsal. Humeral and caudal spots distinct; body without silvery band. One of the specimens has a broad oblique dark band across the middle of the dorsal fin.

Two specimens, 4 inches long, were in the collection.

Cynodon pectoralis, n. sp.

This species is closely allied to *C. scombroides*, but has a greater number of rays in the anal fin, and a much longer and larger pectoral fin.

D. 13. A. 48. P. 19. V. 10.

The height of the body is two-sevenths of the total length (with the caudal), the length of the head nearly one-fifth. Scales very small, those of the lateral line about twice the size

* I observe, in a letter of Prof. Agassiz, addressed to and published by M. Milne-Edwards, that a new genus of freshwater *Belonidæ* from the Amazons is mentioned. I suppose this to be the same fish which was discovered by Mr. Bates some fifteen years ago, and is described in the 'Catal. Fish.' vi. p. 256, as *Potamorrhaphis* (*Belone*) *tæniata*.

of the others. Dorsal fin above the middle of the interspace between the root of the ventral and anal, somewhat nearer to the latter. Anal low, scaly, anterior rays imbedded in fat. Caudal short, rounded. The pectoral extends somewhat beyond (in *C. scombroides* not quite to) the vertical from the origin of the dorsal, its length being one-third of the total without caudal (in *C. scombroides* rather less than two-sevenths). Ventrals well developed. A small black spot on the root of the lower pectoral rays. The humeral spot and one on the adipose fin are present, as in *C. scombroides*.

Seven inches long.

VIII.—*On the Fossils contained in a Lower Greensand Deposit of Phosphatic Nodules in Bedfordshire.* By J. F. Walker, F.C.S., Sid. Suss. College, Cambridge.

The increasing demand for phosphatic manure has led to the opening, a short time since, of new workings for the extraction of nodules containing earthy phosphates, near Sandy, in Bedfordshire. A short account of this deposit was communicated by the Rev. P. B. Brodie to the 'Geological Magazine,' and published in that journal for April last. The deposit is referred to the Lower Greensand; but nearly all the fossils contained in it have been derived from the wreck of preexisting formations. Mr. Brodie mentions an imperfect cast of a species of *Rhynchonella* as the only fossil of animal origin observed by him which appeared to belong to the bed; I have obtained a species of *Corbis*, nearly allied to *Corbis corrugata*, Sby. of the Lower Greensand of the southern counties, and have seen a species of *Terebratula*, both presenting precisely the aspect of Lower Greensand fossils, and exhibiting no traces of having been rolled.

Of the introduced fossils, the greater part appear to have been derived from the Kimmeridge Clay. Among these are casts of the interior of species of *Cardium* and of two other bivalves, and of a large *Pleurotomaria*, much worn,—several fragments of the dorsal spines of *Asteracanthus ornatissimus* and a small portion of a spine of *Hybodus*,—numerous palatal teeth of *Sphærodus gigas*, and a single curved palatal tooth of *Pycnodus*. Several teeth of *Pliosaurus* and some teeth of apparently crocodilian character also occur.

The Oxford Clay has furnished four species of *Ammonites*, and a phragmocone of a Belemnite; and several vertebræ and teeth of *Ichthyosaurus* and *Plesiosaurus* are also probably derived from this formation.

But the most interesting point that I have ascertained with re-

gard to this deposit, and which indeed induces me to make this communication, is the occurrence in it of water-worn remains of *Iguanodon*. Of this reptile I have obtained one of the phalanges, a worn tooth, vertebræ, and one or two other fragments. The presence of these rolled fossils so far beyond the present area of the Wealden, coupled with the occurrence of numerous fragments of fossil wood strongly resembling that found in the Purbeck beds, seems to prove that, previously to the formation of this deposit, an extensive denudation of Wealden strata must have taken place in this district.

IX.—*Notes on the Palæozoic Bivalved Entomostraca.* No. VII. *Some Carboniferous Species.* By T. Rupert Jones, F.G.S., and James W. Kirkby, Esq.

With the view of working out the characters and classification of the Bivalved Entomostraca of the Carboniferous Rocks, we have had to determine the specific value of the forms already published by palæontologists. In the 'Annals and Mag. Nat. Hist.' for May 1865 (ser. 3. vol. xv. p. 404, &c.) we gave the results of our examination of some Bavarian specimens (with which Dr. C. W. Gümbel obligingly favoured us), whereby we were enabled to determine Count Münster's eight Carboniferous species—the oldest on our list, having been published in 'Leonhard's Jahrbuch' for 1830.

1793. *Ure.*—Before proceeding to discuss the species published subsequently to 1830, we have to notice some figured but unnamed forms, well known to the students of Scottish geology, who have to refer to Ure's 'History of Rutherglen and East Kilbride' (8vo, 1793). In this work the Rev. David Ure noticed the existence of certain "microscopic bivalved shells" (Entomostraca) in the Carboniferous Limestones near Glasgow, and supplied his friends with suites of these little fossils, together with minute Gasteropods; and tastily mounted sets, in glazed frames, are still preserved in the Hunterian Museum in the Royal College of Surgeons, London, and in the Museum of the Andersonian University, Glasgow. (See the very interesting 'Biographical Notice of the Rev. David Ure,' &c., by John Gray, 8vo, Glasgow, 1865.) "Both John Hunter and Dr. Anderson were friends of Ure; and as these microscopic fossils were found in Hunter's native parish, they would be the more prized on that account." (Mr. John Young, *Letter*.)

Four or five of the little Entomostraca were figured and described by Ure in his 'History of Rutherglen,' &c. One of them (pl. 14. fig. 15), a subreniform *Cythere* (?), small, white,

and polished, was the most numerous of those mentioned; another, also white and polished, but larger and scarcer, is subtriangular, and evidently a *Bairdia* (fig. 20), somewhat crushed —a condition noticed by Ure; it was rare, in a limestone-quarry fifteen miles west of Newcastle-on-Tyne, near the spot where the Roman wall is intersected by Watling Street. Figs. 16,17, and 21 are given as different views of one form, the scarcest of all: fig. 21 is certainly a *Kirkbya* badly drawn; and the other two are Beyrichian in appearance (*Beyrichia bituberculata*, M'Coy, sp.).

Among the mounted specimens in the Hunterian Museum are *Leperditia Okeni*, Münster, var., *Cytherella*, *Bairdia curta*, M'Coy, *B. subcylindrica*, Münster, and the *Kirkbya* roughly indicated by Ure's fig. 21, which is *K. Urei*, Jones (Trans. Tyneside Nat. Field-Club, 1859, p. 136; and Gray's 'Biograph. Notice,' &c., p. 52).

Dr. Ure's microscopic specimens seem to have been collected chiefly at Lawrieston and Stuartfield (East Kilbride). It is only of late that the energetic geologists of Glasgow have been able to rediscover the exact strata which yield them. In a letter dated July 4, 1865, our friend Mr. John Young, of Glasgow, states—

"Since I began to pay any attention to the collecting of Entomostraca, I have often searched for the bed in which David Ure obtained the specimens figured in his book, and also mounted in the Hunterian Museum in London and in the collection of the Andersonian Institution in Glasgow; but as the quarries from which he got them have been filled up, and as Ure does not tell the nature of the strata from which he collected them, I have never been able to find them until the last week or two. In examining some shale from the Calderside old limestone-quarries, near High Blantyre, Lanarkshire, I was fortunate in again discovering Ure's bed for the *Kirkbya*, &c. It lies between two beds of limestone, which crop out in both Blantyre and East Kilbride parishes. This bed of shale is loaded with organisms in a more or less perfect condition, namely Corals, Polyzoa, Brachiopoda, Conchifera, Crinoids, Bivalve Entomostraca, Trilobites, &c. The shale soon breaks up on exposure to the weather, and then the minute organisms can easily be extracted from it by washing." Mr. John Young then refers to some mounted specimens of *Bairdiæ*, *Kirkbyæ*, *Cytherellæ*, and *Foraminifera*, from this shale, that were kindly sent in his letter, and adds, "I find, on comparing the figures given by Ure with the Entomostraca from Calderside, that he has made a mistake in confounding two distinct forms as belonging to the same species. Figs. 16, 17, and 21 he thought were the same. I find

that figs. 16 and 17 are intended to represent *Beyrichia bituberculata,* M'Coy, sp., which is sparingly found in the Calderside shale together with *Kirkbya Urei,* Jones, which Ure produces in fig. 21. It is strange that he should have made this mistake, as the two shells are quite distinct to the naked eye under every aspect."

1834. *Hibbert.*—In 1834, Dr. Hibbert brought to the notice of the British Association at Edinburgh, and in 1836 he described, in the 'Transactions of the Royal Society of Edinburgh' (vol. xiii.), some Entomostraca from the Carboniferous strata near Burdiehouse, which are rich in these minute carapaces, mostly, however, belonging to one species*. At page 179 of his memoir he gave small woodcut figures of his *Cypris Scotoburdigalensis,* and at page 180 others of his *Daphnoidia.* The latter received the name of "*Hibberti*" in Morris's 'Catalogue of British Fossils,' first edition, 1843. Dr. Hibbert's specimens were again noticed by Mr. L. Horner in the 'Edinburgh New Philosophical Journal' for April 1836, and were regarded as indicating an estuarine (and not a freshwater) origin for the strata containing them.

Among the many Carboniferous specimens lent to us by our friend Mr. E. W. Binney, F.R.S., are several bearing minute Entomostraca that were in Dr. Hibbert's collection. In these, "*Cypris Scotoburdigalensis*" is abundant; but *Daphnoidia,* unfortunately, does not appear. Nor can we form a satisfactory conclusion as to the nature of this little fossil from Dr. Hibbert's woodcuts. The so-called "*Cypris*" is readily recognized to be a dwarf *Leperditia,* with the characteristic muscle-spot, and possessing even the hump on the back of the left valve, so marked a feature in some members of that genus. Excepting in relative size, no distinction can be discerned between *Leperditia Scotoburdigalensis* and *L. Okeni*; and we find very many gradations in size among these little *Leperditiæ* of the Carboniferous shales and limestones, including *L. Okeni* as a large form and *L. Scotoburdigalensis* as the smallest. Two or more of these varieties are often associated together, sometimes probably as young and old conditions, but often as varieties determined by mode of growth. Some slight differences in the outline of the valves, or in the profile of the carapace, occasionally accompany variation in size; and, taking these together, we use them as

* In more than one of the many samples of the Burdiehouse limestone and shale that we have examined, we have noticed what appears to be a more elongate (and *Cythere*-like) form than *Leperditia Scotoburdigalensis*; but the specimens are so imperfect as not to be determinable. We may say the same in respect to other crushed specimens from this locality, that resemble *Beyrichia subarcuata,* Jones.

distinctions for nominal varieties. Thus *L. Scotoburdigalensis* may be allowed to stand as a sufficiently distinct variety of *L. Okeni*, though possibly it really differs only in having been dwarfed by unfavourable circumstances of growth.

In the Lower Carboniferous shales and limestone of Burdiehouse* we see *Leperditia Scotoburdigalensis* in company with *Spirorbis* (*Microconchus*) *carbonarius* (not very abundant there), abundant Fish-remains, *Lepidodendron, Lepidostrobus, Sphenopteris*, &c.

This smallest of the many varieties of *Leperditia Okeni*, occurring in the Lower Carboniferous limestones and shales of Great Britain and Ireland, has been found at Burdiehouse (by Hibbert, Horner, Binney, Sorby, Crosskey, the Geological Surveyors, and others); Granton (Harkness); Pittenweem, in Fifeshire (Hunter); Bathgate (Young); Arundale, near Bathgate (Young); Hurlet, S.W. of Glasgow (Crosskey); Carluke (Rankine); Lammerton and Cockburnspath, Berwickshire (G. Tate); and at many places in Ireland by Sir R. Griffith and the Geological Surveyors. (See further on.)

One of us long ago saw that this little Entomostracan could not be a *Cypris*, nor a *Cythere*, and put it with *Cytheropsis* (a provisional genus). Hence it appears under that name in the 'Monograph of the Fossil *Estheriæ*' (Palæontographical Society, 1862) and in some other works. It was definitely referred to *Leperditia* by us in 1863 (Brit. Assoc. Report, 1863, Sections, p. 80; and 'Geologist,' vol. vi. p. 460).

1836. *Bean.*—In 1836 Mr. W. Bean, of Scarborough, described in the 'Magazine of Natural History,' vol. ix. p. 377, a little Entomostracan from the Coal-measures of Newcastle-upon-Tyne, as *Cypris arcuata*; and illustrated it by a woodcut (fig. 55). This is really a *Beyrichia*, and has been so referred to, on the authority of one of us, for several years past.

Beyrichia arcuata is one of the most widely distributed Entomostraca in the Coal-measures of England and in the "Upper Coal-measures" of Scotland. It has also been found in the shales of the so-called "Millstone-grit" of Lancashire and in the Lower Carboniferous shales of Scotland, but not in the Mountain-limestone, or equivalent portions of the Carboniferous Series, in England. We have it from the Ryhope Colliery, near Sunderland, in shale, about 8 or 10 feet below the base of the Permian strata; from Claxheugh, near Sunderland, in ironstone; from Hylton, near Sunderland, in ironstone; from Prestwick, Northumberland, in carbonaceous shale (Atthey); from Loughton,

* For a full account of the Carboniferous Strata of Burdiehouse, see the 'Memoirs of the Geol. Survey,' &c.: "Geology of the Neighbourhood of Edinburgh," by Howell and Geikie, 1861, p. 36, &c.

Staffordshire, in shale (J. Ward); in ironstone from the Coal-measures near Dudley (Geol. Survey); from Chesterfield in ironstone (Binney); from Babbington, Notts, in shale; from Shaley Brow, Rainford (Binney); from Glodwick, near Oldham (Binney); from Agecroft Colliery, near Manchester (Binney); from Ashby-de-la-Zouch (A. H. Green); from Eagley Shore, Lancashire, and from Holcombe, Bradshaw, Cranbourke, and Brow Peel in the same county; from Granton (Harkness); from Carluke (Rankine); and from the shales associated with the Shotts Gas- and Furnace-Coals, Lanarkshire (Grossart).

In the 'Memoirs of the Geological Survey,' illustrative of the several sheets of the Geological Survey Map, are several references to the occurrence of Bivalve Entomostraca in the Coal-measures. *Beyrichia arcuata* is quoted as occurring in shales of the Middle and Lower Coal-measures of Lancashire and of the "Holcombe-Brook Series" (referred to the "Millstone-grit" by the Surveyors) in the same district: Mem. Geol. Surv., "Geology of the Country around Bolton-le-Moors," by Mr. E. Hull, 1862, pages 33, 34, 40, &c. *B. arcuata* is also mentioned as belonging to the Middle Coal-measures, near Wigan, in the 'Geology of the Country near Wigan,' 2nd edit. 1862, Appendix *, by Mr. Salter, pp. 36 and 38, and is figured in a woodcut at p. 37 (fig. 2, 5).

1836. *Phillips and Williamson.*—In 1836 Professor J. Phillips (Brit. Assoc. Report, 1841, Sections, p. 64) and Professor W. C. Williamson (Phil. Mag. new series, vol. ix. p. 351) discovered numerous small Entomostraca in the Upper Coal-measures at Ardwick, near Manchester (see 'Monograph Foss. Estheriæ,' Pal. Soc. p. 118). Excepting a few specimens of *Leaia*, these Entomostraca were referred to as *Cyprides*, and are possibly the same as *Cypris inflata* of Murchison, which is found in the uppermost Coal-measures of Shropshire.

1839. *Murchison and Sowerby.*—In 1839 Sir Roderick Murchison and Mr. J. de C. Sowerby described and figured a small Bivalve Entomostracan (obtained by the former from the Upper Coal-measures of Shropshire) as *Cypris inflata*, in the 'Silurian System,' p. 84, woodcuts figs. A 1, A 2, A 3, which figures were repeated in 'Siluria,' 1st and 2nd editions (2nd edit. 1859, p. 322, fig. 83), and have been copied in other works on geology. These illustrations are really those of a small gibbous *Leperditia*,—with a straight back, strong dorsal angles, and convex ventral margin. In the 'Silurian System,' p. 84, it is

* In this Appendix, p. 37, fig. 2, 4, is figured another *Beyrichia* (under the name of "*B. Binneyana*, Jones"), which is *B. subarcuata*, Jones, Pal. Soc. 1862, Monogr. Foss. Esth. p. 120, pl. 5. fig. 16. The name "*B. Binneyana*" was intended for a different form as yet unpublished.

stated that a band of freshwater limestone stretches from Nobold near Shrewsbury to Asterley beyond Pontesbury, and is found in the Coal-measures between Westbury and Pontesbury; and it is described as containing *Cypris inflata*, together with *Spirorbis* (*Microconchus*) *carbonarius*, and as being equivalent to the Ardwick limestone, in which this latter little fossil also abounds. This Spirorbis-limestone occurs also in the uppermost Coal-measures of Warwickshire. See Geol. Survey Memoirs, 1859.

Mr. J. W. Salter has obtained for us, through the kind aid of Mr. R. Wilding, of Church-Stretton, a specimen of the whitish so-called "freshwater" limestone of the Upper Coal-measures of Lee-Botwood, Shropshire. This contained a few specimens of a dwarf *Leperditia* and many minute *Spirorbes* * (*Microconchi*). Mr. E. W. Binney has also favoured us with specimens of the same Spirorbis-limestone from Ardwick, near Manchester; Prizely, Shropshire; Rough Gill near Galescales, Carlisle; and from the banks of the Ayr near Catrine, Ayrshire. Some of these specimens enclose imperfect individuals of the same dwarf *Leperditia*. In another specimen of the white limestone that we have seen in the Ludlow Museum, *Spirorbis* abounds, but no Entosmostraca are visible.

On account of the compact and crystalline condition of this rock, it is very difficult to manipulate the little bivalve carapaces, or their representative casts in the limestone; but, though not so successful as we wished, we had evidence of such a little *Leperditia* as that figured by Murchison and mentioned above; and we have no doubt that this is very similar to *L. Scotoburdigalensis*, its greater breadth or ventricosity alone distinguishing it. Hence we may keep the varietal name *L. inflata* for the gibbous dwarf form of *L. Okeni* occurring in the south, whilst *L. Scotoburdigalensis* is an equally small, but less swollen, dwarf variety, found in the north of Britain, as well as in Ireland.

1839. *M'Coy*.—In 1839 Professor F. M'Coy figured and described as *Entomoconchus Scouleri*, in the Journal of the Geological Society of Dublin (vol. ii. p. 91, pl. 5. figs. *a–e*), a large globose bivalved Entomostracan, common in some parts of the Mountain-limestone, both of the British Isles and the Continent. This form had already been recognized as occurring in the Mountain-limestone of Yorkshire (Bolland) by Professor John Phillips, and referred to by him in his 'Geology of the Mountain-Limestone District of Yorkshire,' pages 240 and 251, as a "Cypridiform shell," but not described, though sketches of

* *Spirorbis* (*Microconchus*) is abundant also in some of the limestones of the Middle and Lower Coal-measures and of the Limestone-shales (Ireland).

it are given in pl. 22. figs. 23 & 24 of that work. In a provisional notice of the Entomostraca of the Carboniferous period*, we have been enabled to point out some of the relationships of this curious fossil, in M'Coy's figures of which the hinge-line is by mistake assigned to the anterior extremity.

This fossil is known to us by specimens from the Carboniferous Limestone of Cork, Kildare, Meath, and Limerick (Griffith, D. Sharp, J. Wright, British Museum, Geological Survey); Bolland, Yorkshire (Phillips, Morris); Park Hill, near Longnor, Derbyshire (Geol. Survey); Lower Scar Limestone, Settle (Burrow); Braidwood Limestone, Carluke (Hunter); Carboniferous shales of West Broadstone, Ayrshire (J. Young). The Rev. J. Cumming found it in the Carboniferous Limestone of the Isle of Man (Quart. Journ. Geol. Soc. vol. iii. pp. 322, 355). At Visé, in Belgium, it is not rare in the white Carboniferous Limestone.

1842. *De Koninck.*—In 1842 six species of Bivalved Entomostraca from the Carboniferous Limestone of Belgium were carefully figured and described by Professor Dr. L. de Koninck, of Liége, in his 'Description des Animaux Fossiles qui se trouvent dans le Terrain Carbonifère de Belgique' (4to, Liége, 1842–44). At page 585, under the name *Cythere Phillipsiana* (pl. 52. fig. 1), we have the peculiar gibbous form common in some of the beds of the European Mountain-limestone, and which had been named *Entomoconchus Scouleri* by M'Coy in 1839. At page 587 De Koninck describes his *Cypridina Edwardsiana* (pl. 52. fig. 2), and *C. concentrica* (fig. 4), and at p. 588 his *C. annulata* (fig. 3); but the generic affinities are not well determined, owing probably to the fact of the peculiar antero-ventral notch in the valves of *Cypridina* having been omitted in the engraving of Milne-Edwards's typical species (as explained in the 'Monograph of the Tertiary Entomostraca of England,' Pal. Soc. 1856, p. 9), and the palæontologist having been thereby misled in collocating the fossil carapaces with their recent analogues. At page 589 of M. de Koninck's work, his *Cyprella chrysalidea* (pl. 52. fig. 6) is described, and his *Cypridella cruciata* (fig. 7) at page 590.

These Entomostraca occur also in Great Britain, as well as the curious Crustaceans, *Cyclus Brongniartianus*, Kon., and *C. radialis*, Phillips, sp., described and figured in the same memoir, but of obscure relationship. A form allied to the latter has also been found by Mr. Joseph Wright in the Carboniferous Limestone of Little Island, Cork, and by Mr. J. H. Burrow at Settle; another belongs to the Magnesian Limestone of Sunderland;

* Report of the British Association, 1863, Sections, p. 80.

and a much earlier instance of the occurrence of the genus is in the Silurian Limestone of Keisley in Westmoreland, where it was discovered in 1864 by Professor R. Harkness, F.R.S.

A collection of Belgian Bivalve Entomostraca presented to one of us a few years ago by M. J. Bosquet, of Maestricht,—a collection of fossil *Cyprinidæ* from Little Island, Cork, sent us by Mr. Joseph Wright, F.G.S.,—and a collection submitted to us by Mr. J. H. Burrow, M.A., of Settle, Yorkshire, enable us to unravel some of the obscurities of this group, which had its representatives even in Silurian times*, and is still largely represented in the present seas. We intend, however, on the present occasion merely to mention what we believe to be the real relationships of M. de Koninck's species, as already indicated in the 'Neues Jahrbuch' for 1864, p. 54, and in the 'Canadian Naturalist and Geologist,' new series, vol. i. p. 237, where we have stated that M'Coy's *Daphnia primæva* is a *Cypridina*, De Koninck's *Cypridina Edwardsiana* and *Cypridella cruciata* are *Cypridellæ*, his *Cypridina annulata* and *Cyprella chrysalidea* are *Cyprellæ*, and his *Cypridina concentrica* is an *Entomis*.

1843. *Portlock.*—In 1843 the late General (then Captain) Portlock, in his Report on the Geology of Londonderry, p. 316, treated of two Entomostraca from the Carboniferous Shales of Derry, Tyrone, and Fermanagh, Ireland, namely *Cypris Scotoburdigalensis* (Hibbert) and *Cypris subrectus* (Portlock); and illustrated the former by fig. 13 *c*, and the latter by fig. 13 *b*, of his plate 24. *C. subrecta* (the original specimen of which we have seen, by the kindness of the officers of the Geological Survey Museum, Jermyn Street) is very similar to the first-named in shape, but is somewhat larger. Both are varieties of *Leperditia Okeni*; and, together with numerous very similar comrades, they infested the salt and brackish waters of the early Carboniferous period in nearly every region of the northern hemisphere, acting as scavengers† on the decaying animal and vegetable materials in the muddy shallows and lagoons. As *Leperditia subrecta* represents a size above that of *L. Scotoburdigalensis*, and does not *exactly* correspond to any of the Bavarian

* In the pebbles of Silurian quartzite in the Conglomerate at Budleigh-Salterton (Quart. Journ. Geol. Soc. vol. xx. p. 283; and Geol. Mag. vol. i. p. 5), Mr. Salter has discovered a specimen very closely allied to *Cypridina*; and Mr. G. Haswell has found others in the Upper Silurian beds of the Pentland Hills.

† Since the publication of the 'Monograph of the Fossil *Estheriæ*,' Pal. Soc. 1862, in which allusion is made to the garbage-eating habits of the small Entomostraca, we see that Prof. Phillips, as far back as 1841, pointed out the common association of Fish-remains with Cyprids (Brit. Assoc. Rep. 1841, Sections, p. 65).

forms described in our former memoir, it will be convenient to retain the name as that of a variety.

In the second part of his 'Verstein. Grauwacken Sachsens' (1853), p. 23, Dr. Geinitz described a small Bivalve Entomostracan, which he termed "*Cytherina subrecta*, Portlock," and which he found at the Gunzenberg, near Plauen, in company with the tail-spines of *Dithyrocaris Murchisoni*; and he remarked that, as Portlock found his specimens with *Dithyrocaris*, the circumstances are alike for the Silurian and the Carboniferous organisms. But Geinitz's *Cytherina subrecta*, as illustrated by him at pl. 19. fig. 20 of the work above referred to, is very different in appearance from Portlock's *C. subrecta*, being narrower in proportion, *incurved* both on the dorsal and ventral margins, bordered by a flat rim (apparently) all round, and rounded equally at the ends. The Silurian spines of the so-called "*Dithyrocaris*" are very probably those of *Ceratiocaris.*

Leperditia Okeni of the size and form of *L. subrecta* occurs at Fermanagh, Ireland (Portlock); Blackwell, near Bristol (Moore); Great Orme's Head (Dr. Holl); Whorlton, Teesdale (Parker); Wyebourne, Cumberland (Bland); banks of the Wansbeek (Pecket); Barnard Castle (Barron); Carluke (Hunter); West Broadstone, Ayrshire (Thomson); Orchard, near Thornliebank (Armstrong); Gare, Carluke (Thomson); Howrat Quarry, near Dalry (Armstrong); Craigenglen (Young and Crosskey); Campbeltown (Thomson); Carboniferous Limestone, Ashford, Derbyshire (Geol. Survey); Carboniferous Shales, half a mile south of Mitcheldean (Geol. Survey); and at many places in Ireland (Griffith and Geological Surveyors). See further on.

1844. *M'Coy.*—In 1844 Professor M'Coy considerably enlarged our knowledge of the Entomostraca of the Carboniferous Rocks by the description and illustration of twenty-two forms (including *Entomoconchus Scouleri*), besides two species of *Dithyrocaris* (*D. Scouleri* and *D. tenuistriatus*), all from the Lower Carboniferous strata of Ireland.

Thanks to the courtesy of Sir Richard Griffith, Bart., we have been enabled to examine many of the specimens described by Prof. M'Coy, and thereby to make our comparisons more surely.

The localities of nearly all the specimens described by M'Coy (and all that we have had in hand) have been given by Sir R. Griffith in the 'Journal Geol. Soc. Dublin,' vol. ix. (1860), pp. 21 &c.; and indeed the specimens retain their original labels, with the localities indicated.

On comparing the specimens with the figures in the 'Synopsis of the Characters of the Mountain-Limestone Fossils of Ireland,' pl. 23. figs. 4–25, we fail in recognizing several of M'Coy's

species on the hand-specimens bearing their names on the labels: they may perhaps have fallen out*. Some of the figures referred to represent, we are sure, only modified conditions of carapaces, either partially imbedded in the matrix or altered by pressure; some are for certain badly drawn; and in many cases the edge-views of the carapaces must, we think, have been constructed from the lateral profiles of imbedded valves, and are therefore rarely of much value†.

The figures in Prof. M'Coy's plate 23 are not drawn on a true scale; so that some specimens $\frac{1}{2}$ line long have larger figures than some one line long.

Having carefully examined the several labelled hand-specimens of shale and limestone lent to us by Sir R. Griffith, we propose to make some remarks on the Entomostraca that we have met with in them; and at the same time we shall offer our opinion on such of Professor M'Coy's species as are figured in pl. 23 of the 'Synops. Charact. M. Limest. Foss. Ireland,' but have not reached us, or are not now to be seen on the hand-specimens.

1. "*Entomoconchus Scouleri.* Lower Carboniferous Limestone; Little Island, Cork." Synops. Carb. Foss., Ireland, p. 164, pl. 23. fig. 4. Griffith, List of Localities (Journ. Geol. Soc. Dublin, vol. ix.), p. 68. A cast, in grey crystalline fossiliferous limestone.

1*. Another cast, in similar limestone; Millicent, Clane, co. Kildare.

1**. Another specimen (labelled "*E. Scouleri.* Upper Carboniferous Limestone; Black Lion, Enniskillen, co. Leitrim," Localities, p. 80) is a dark-coloured crystalline shelly limestone with a *Cyclus.*

2. "*Daphnia primæva.*" Synops. p. 164, pl. 23. fig. 5. Stated to be $1\frac{1}{3}$ long, and $\frac{3}{4}$ line deep, not very uncommon in some localities, and possibly to be the same as Hibbert's *Daphnoidia.* The specimen was not sent to us, nor is it mentioned in the List of Localities, and has therefore probably been mislaid. It certainly is a *Cypridina* as far as the appearance of the valve is concerned, whatever Dr. Hibbert's specimens may have been (see above, p. 34).

3. "*Bairdia curtus.* Arenaceous shale; Granard, co. Long-

* In the 'Dublin Quarterly Journal of Science,' No. XIX. July 1865, Mr. John Kelly explains that in 1853 Sir R. Griffith's collection, comprising these specimens, was removed from his house to the Great Exhibition in Dublin, and that many of the specimens of shale crumbled away. Hence, probably, the loss of several specimens.

† In 1847 M. J. Bosquet, in his "Descript. Entom. Foss. Maestricht," p. 4, *note*, offered some criticisms on M'Coy's species, but not sufficiently well founded to be of use.

ford." Synops. p. 165, pl. 23. fig. 6; Local. p. 100 ("Carboniferous slate and arenaceous limestone," Local. p. 48). Grey limestone, with *Spirifer*, Crinoids, &c., and some obscure Entomostracan valves besides the *Bairdia* under notice. This is in good preservation. In 1859 one of us carefully examined the specimen, and, having cleared away some of the matrix, considered the carapace to have been sufficiently well shown, and regarded it as being somewhat different from *Bairdia plebeia*, Reuss, in exhibiting less convexity in the antero-ventral edge. Unfortunately this very convexity could even then have been found by greater boldness of manipulation; for a year afterwards, on again closely examining the specimen, it came out of the stone, quite perfect, showing a fully curved hatchet-edge, as in *B. plebeia*.

After the many doubts expressed as to the identity of the Carboniferous *B. curta* and the Permian *B. plebeia*, we cannot now recognize (with Sir R. Griffith's specimen clearly before us) a real specific distinction; and *B. curta* stands as the oldest name. *B. plebeia*, however, may conveniently remain as a term of inferior grade for the very prevalent form with a rounded antero-dorsal angle (and hence less hatchet-shaped anterior extremity, as depicted in Reuss's figure of *B. plebeia*, Jahresbericht Wetterau. Gesell. 1854, p. 67, fig. 5, and in those given in the Transact. Tyneside Field-club, vol. iv. pl. 9. figs. 1, 2, 4, and woodcut 1, p. 145).

4. "*Bairdia gracilis.*" Synops. p. 165, pl. 23. fig. 7. As we have not seen this specimen, and as it is not referred to in the List of Localities, we have nothing to add to Prof. M'Coy's brief description of it, except that it seems to be the same as *B. subcylindrica*, Münster, sp. (Annals N. H. ser. 3. vol. xv. p. 409, pl. 20. fig. 13).

5. "*Cythere amygdalina.*" Synops. p. 165, pl. 23. fig 8. We have not seen this specimen; and, not being mentioned in the List of Localities, it has probably been mislaid. We have seen, however, a form corresponding to fig. 8 in the hand-specimen described further on as No. 10. Prof. M'Coy states that "*C. amygdalina*" is "common."

6. "*Cythere arcuata.* Yellow Sandstone; Dromard, Draperstown, co. Londonderry." Synops. p. 165, pl. 23. fig. 9; Local. p. 48 ("Arenaceous shale," Local. p. 100). A blackish micaceous shale, rather hard but fragile, containing *Modiolæ* (?), and abounding with small Entomostraca, *Leperditia subrecta*, *L. Scotoburdigalensis*, *Kirkbya annectens* (sp. n.), and others, but nothing corresponding to the figure given of "*C. arcuata*," which we are inclined to believe to have been a specimen of *L. subrecta* partially hidden by matrix on its dorsal region. Prof. M'Coy

states that "*C. arcuata*" is "very common in the Carboniferous shales."

7. "*Cythere bituberculata.* Yellow Sandstone; Cultra, Holywood, co. Down." Synops. p. 165, pl. 23. fig. 10; Local. p. 48 ("Arenaceous shale," Local. p. 100). Light-grey shaly shell-grit, with *Modiolæ* (?), slightly micaceous. *Leperditia subrecta* abundant, and smaller obscure Entomostraca present, but nothing like the figure. A very similar, if not identical *Beyrichia*, however, occurs in Scotland (in the Coal-measures near Glasgow), and will bear the name *B. bituberculata*, M'Coy. Prof. M'Coy found his "*C. bituberculata*" common in one or two localities.

8. "*Cythere costata.* Yellow Sandstone; Cultra, Holywood." Synops. p. 165, pl. 23. fig. 11; Local. p. 48 ("Arenaceous shale," Local. p. 100). Light-grey solid shell-grit (*Serpulæ*, &c.), with crushed valves of *Leperditia subrecta* in abundance; but nothing visible to match the figure. We have, however, met with a *Kirkbya* in the Carboniferous Limestone of the south-west of England somewhat like fig. 11. Prof. M'Coy refers to "*C. costata*" as being about $\frac{1}{3}$ line in length, rare, and solitary.

9. "*Cythere cornuta.* Yellow Sandstone; Cultra, Holywood." Synops. p. 165, pl. 23. fig. 12; Local. p. 48 ("Arenaceous shale," Local. p. 100). Hard grey calcareous shale, with fish-scales and *Serpulæ*; or rather a Serpula-grit, much like the foregoing. *Leperditia Scotoburdigalensis* and *Kirkbya annectens* are present, but not the figured specimen. This we believe to have been *L. subrecta* with an extraneous morsel of matrix attached near the middle of the hinge-line (taken for the ventral border in Prof. M'Coy's description). It is stated to be about a line long and "not common."

10. "*Cythere elongata.* Yellow Sandstone; Cultra, Holywood." Synops. p. 166, pl. 23. fig. 15; Local. p. 48 ("Arenaceous shale," Local. p. 100). Grey Serpula-grit, with *Modiola* (?). There is no specimen like the figure (which appears to be an oculate *L. subrecta*, with its dorsal region buried in the matrix) now visible on the slab; but there are *L. Scotoburdigalensis*, *Kirkbya annectens*, two *Cytheres*, and a *Leperditia* (?) like fig. 8, "*Cythere amygdalina.*" M'Coy's "*C. elongata*" is stated to be half a line long and "very common in the shales of certain localities" (p. 166).

11. "*Cythere excavata.* Carboniferous Slate; Aghnaglogh, Clogher, co. Tyrone." Synops. p. 166, pl. 23. fig. 14; Local. p. 48 ("Arenaceous shale," Local. p. 100). Dark-coloured, shelly, fissile shale, with *Anthracomyæ* (?) and obscure casts of *Leperditia subrecta*; and the figure seems to have been based on some such specimen.

12. "*Cythere Hibbertii.* Yellow Sandstone; Larganmore, Bangor, co. Mayo." Synops. p. 166, pl. 23. fig. 15; Local. p. 48

("Arenaceous shale," Local. p. 100). Dark, fragile, slightly micaceous shale, with Crinoids, *Modiola* (?), &c., and containing obscure valves and casts of *Leperditia subrecta* (?) and *Kirkbya annectens*, but nothing exactly corresponding to the figure. Prof. M'Coy suggests that this "is perhaps *Cypris Scotoburdigalensis* of Hibbert; but this dwarf form of *L. Okeni*, smaller even than the variety *subrecta*, would hardly match "*C. Hibbertii*," which is stated to be "frequently upwards of a line in length," and "the largest species of *Cythere* of the Irish palæozoic rocks" (though "*C. inflata*" is said to reach 2 lines in length), except when regarded as one of the modifications of *L. Okeni*, which we believe to be the correct view of its relationship, though not contemplated in the work before us.

13. "*Cythere impressa*. Yellow Sandstone; Dromard, Draperstown. Synops. p. 166, pl. 23. fig. 16; Local. p. 48 ("Arenaceous shale," Local. p. 100). Grey, fine-grained, micaceous, hardish shale, with *Modiola* (?) and *Serpula*. Some obscure casts of *Leperditia subrecta* and of other Entomostraca are present; but there is nothing exactly like the figure, which is stated to represent a form about half a line long, and "very common in the slates and shales of several districts" (p. 166).

14. "*Cythere inflata*. Lower Carboniferous Limestone; Ballyduf, Dungarvon, co. Waterford." Synops. p. 167, pl. 23. fig. 17; Local. p. 68. Grey crystalline shelly limestone, veined. Without any visible specimen of Entomostraca.

14*. White crystalline limestone, from Laracor, Trim, co. Meath (Local. p. 68). This has a small *Entomoconchus* and a minute hollow mould where a *Leperditia subrecta* has probably been. The figure may have been taken from a small *Entomoconchus*, a *Cypridella*, or other nearly related Cypridine Entomostracon.

Prof. M'Coy states that his "*C. inflata*" is the "largest and most abundant" of the Carboniferous *Cytheres* (from 1 to 2 lines in length), and that it abounds in the dark fœtid limestones, but is "rare in the light-coloured limestone, where *C. inornata* supplies its place."

15. "*Cythere inornata*. Yellow Sandstone; Cultra, Holywood." Synops. p. 167, pl. 23. fig. 18; Local. p. 48 ("Arenaceous shale," Local. p. 100). Bluish-grey fissile shale, fine-grained and micaceous, with numerous casts and broken valves ($\frac{1}{24}$ to $\frac{1}{12}$ inch long) of *Leperditia subrecta* and *L. Scotoburdigalensis*, sometimes showing the eye-spot. Prof. M'Coy states that his "*C. inornata*" is rarely $\frac{1}{2}$ line in length, and that it is "very common in several localities."

The Permian *Cythere* referred by one of us to *C. inornata*, M'Coy, is decidedly not the same as this, which is the common dwarf variety of *Leperditia Okeni*, Münster, sp.

16. "*Cythere orbicularis.* Yellow Sandstone; Bunowna, Easky, co. Sligo." Synops. p. 167, pl. 23. fig. 19; Local. p. 48 ("Carboniferous slate," Local. p. 100). Dark-grey, fine-grained limestone, with *Orthoceras*, &c. There are some small, obscure, roundish fossils, and a part of a valve of *L. subrecta*, but nothing like the figure.

17. "*Cythere pusilla.*" Synops. p. 167, pl. 23. fig. 20. "Yellow Sandstone; Cullion, Draperstown, co. Londonderry," Local. p. 48. "Middle Limestone," Local. p. 100. We have not had the specimen. It may have been a very small *Entomoconchus* (?) or a *Cypridella.* Prof. M'Coy refers to it as "the smallest of the *Cytheres*" ... "greatly abundant" ... "length about $\frac{1}{3}$ line" (p. 167).

18. "*Cythere scutulum.* Middle Carboniferous Limestone; Ballintrillick, Bundoran, co. Donegal." Synops. p. 168, pl. 23. fig. 21; Local. p. 75. Dark, compact, but softish, fissile shale, with Crinoidal joints, casts of *Aviculopecten*, &c. *Leperditia Okeni*, var. *subrecta* and *Scotoburdigalensis* are here plentiful, as single valves, of various sizes. Some have the eye-tubercle; and occasionally large left valves ($1\frac{1}{12}$ inch long) have their peculiar dorsal swelling. *C. scutulum* is doubtless *Leperditia subrecta*, Portlock, sp. The figured specimen must have had its dorsal edge partly imbedded, and the proportions are not well given.

19. "*Cythere oblonga.* Yellow Sandstone; Cullion, Draperstown." Synops. p. 167, pl. 23. fig. 22; Local. p. 48 ("Arenaceous shale," Local. p. 100). Dark-grey, fine-grained, fissile shale, with *Aviculopecten.* Obscure casts of *Leperditia subrecta* (?), but nothing that matches the figure. "*C. oblonga*" is stated to be "common," and about 1 line in length. It is probably *L. subrecta.*

20. "*Cythere spinigera.*" Synops. p. 168, pl. 23. fig. 23. We have not seen the specimen; but there is no doubt that it is *Leperditia Okeni* (probably var. *subrecta*), either with the eye-spot prominent, or with a small incrustation, such as we have seen in one of the specimens from Cultra, and such as we believe fig. 12 ("*C. cornuta*") and fig. 24 ("*C. trituberculata*") to have borne.

21. "*Cythere trituberculata.* Yellow Sandstone; Cultra, Holywood." Synops. p. 168, pl. 23. fig. 24; Local. p. 48 ("Arenaceous shale," Local. p. 100.) Hard, grey Serpula-grit, like No. 9, but more solid. We can find nothing like the figure (probably a small *Leperditia* with adventitious concretions or bits of the matrix). *L. Scotoburdigalensis* is present; also a *Cythere* having an outline somewhat near that of the figure; and there are numerous specimens of *Kirkbya annectens*, which, though more or less lobed or tubercled, is not at all like fig. 24.

22. "*Cythere gibberula.* Middle Carboniferous Limestone;

Ballintrillick, Bundoran." Synops. p. 166, pl. 23. fig. 25; Local. p. 75. Darkish grey micaceous shale, with *Aviculopecten.* The specimens are of the same form as "*C. scutulum,*" and are decidedly *Leperditia Okeni,* var. *subrecta* (about $\frac{1}{16}$ inch long). "*C. gibberula*" is said to occur "in great numbers in the shale of some localities." The figure indicates a large hump on the middle of the valves, which Prof. M'Coy notes as remarkable; but the specimens before us are not characterized by any particular protuberance.

The following labelled specimen accompanied the others.

23. "*Cythere subrecta* (Portlock, sp.). Yellow Sandstone; Larganmore, Bangor, co. Mayo." Griffith's List of Localities, Geol. Soc. Dublin Journ. vol. ix. p. 48 ("Arenaceous shale," Local. p. 100). Hardish dark-grey micaceous shale, with abundant small obscure casts of *Leperditia Okeni,* var. *subrecta* (about $\frac{1}{10}$ inch long).

The following table shows the conclusions we have arrived at, judging by evidences and probabilities, respecting the Bivalve Entomostraca figured in pl. 23, 'Synops. Charact. M. Limest. Foss. Ireland:'—

Prof. M'Coy's Names.	Dimensions in lines.	No. in this art.	Corrected Names.
Fig. 4. Entomoconchus Scouleri	10×9	1	Entomoconchus Scouleri.
5. Daphnia primæva	$1\frac{1}{3} \times \frac{3}{4}$	2	Cypridina primæva.
6. Bairdia curtus	1	3	Bairdia curta.
7. —— gracilis	$\frac{1}{2}$	4	B. subcylindrica, *Münster*, sp.
8. Cythere amygdalina......	$\frac{1}{2}$	5	Leperditia amygdalina.
9. —— arcuata...............	$\frac{1}{2}$	6	L. Okeni, *Münster*, sp., var. subrecta, *Portlock*, sp.
10. —— bituberculata	$\frac{1}{3}$	7	Beyrichia bituberculata.
11. —— costata	$\frac{1}{2}$	8	Kirkbya costata.
12. —— cornuta	1	9	Leperditia Okeni, *Münster*, sp., var. subrecta.
13. —— elongata	$\frac{1}{2}$	10	„ „
14. —— excavata	$\frac{1}{2}$	11	„ „
15. —— Hibbertii	1	12	„ „
16. —— impressa	$\frac{1}{2}$	13	Beyrichia (?).
17. —— inflata	$1\frac{1}{2}$	14	Entomoconchus (?) vel Cypridella (?).
18. —— inornata	$\frac{1}{2}$	15	Leperditia Okeni, *Münst.* sp., var. subrecta; vel var. Scotoburdigalensis.
19. —— orbicularis	1	16	Cypridella (?).
20. —— pusilla	$\frac{1}{3}$	17	Entomoconchus (?) vel Cypridella (?).
21. —— scutulum	1	18	Leperditia Okeni, *Münst.* sp., var. subrecta.
22. —— oblonga	1	19	„ „
23. —— spinigera	$1\frac{1}{4}$	20	„ „
24. —— trituberculata	$\frac{1}{2}$	21	„ „
25. —— gibberula...........	$\frac{1}{3}$	22	„ „

Thus it will be seen that we refer figs. 12, 13, 14, 15, 18, 21, 22, 23, 24, and 25 to *Leperditia Okeni* without any doubt. They comprise the varieties *subrecta* (Portlock) and *Scotoburdigalensis* (Hibbert). The locality of fig. 23 is not mentioned; but all the others are from *shales* either of the "Yellow Sandstone," of the "Carboniferous Slate" (fig. 14), or of the "Middle Carboniferous Limestone" (figs. 21 & 25). Figs. 10, 11, & 16 are also in *shales* belonging to the "Yellow Sandstone."

Figs. 4, 6, 17, & 20 refer to specimens in *limestone*—from the "Lower Carboniferous Limestone" (figs. 4 & 17), the "Carboniferous Slate" (fig. 6), or the "Middle Carboniferous Limestone" (fig. 20). Of the locality and matrix of figs. 5, 7, 8, & 23 we have no indications.

In his 'Notice respecting the Fossils of the Mountain-Limestone of Ireland,' &c. (4to, Dublin, 1842), Sir R. Griffith thus divided the Lower Carboniferous formation of Ireland (p. 4).

1. Upper Limestone. 2. Calp or Calp-slate, consisting of alternations of shale and argillaceous limestone, with occasional beds of pure limestone and rarely of sandstone—and less persistent than the Upper and Lower Limestones. 3. Lower Limestone. 4. Carboniferous Slate, or schistose beds, usually calcareous and alternating with argillaceous limestones, similar to those of the Calp. 5. Yellow Sandstone, consisting of sandstones intercalated with slate or shale and occasionally with limestone. Nos. 4 & 5 are wanting in some localities; and sometimes No. 4 only is wanting. (See also Sir R. Griffith's Geological Map of Ireland, with its marginal explanations, 1854.)

At page 22, Sir R. Griffith states that *Entomoconchus Scouleri* occurs in the Lower Limestone of the southern and middle districts of Ireland.

Bairdia curta	occurs in the	middle and northern.
—— *gracilis*	„	northern.
Cythere cornuta	„	northern.
—— *inflata*	„	southern and middle.
—— *inornata*	„	northern.
—— *spinigera*	„	northern.

These determinations were modified probably, and corrected, in Prof. M'Coy's Memoir (1844), and in Sir R. Griffith's List of Localities' in 1860.

The Geological Surveyors of Ireland, however, have found it impracticable to fully adopt Sir R. Griffith's nomenclature of the Lower Carboniferous formation. According to their experience, his "Yellow Sandstone" is not sufficiently definite in its upper

and lower boundaries, being in some places wholly "Carboniferous," at others wholly made up of "Old Red," and elsewhere combining portions of each; and they restrict the term to the upper portion of the Old Red Sandstone series, distinctly below the beds with marine fossils. They consider that the "Carboniferous Slate" (about 150 feet thick), below the "Carboniferous Limestone" (3000 feet), in the north-eastern districts, is the same as the "Lower Limestone Shales" of England, and that the "Carboniferous Limestone" thins away on the south-west and is wholly replaced by the "Lower Limestone Shales" (about 5000 feet), which are there *cleaved*, and therefore known as "Carboniferous Slate." The latter, in consequence, are in the south-west the equivalents of the "Carboniferous Limestone" and "Lower Limestone Shales" together in the north-east.

As this arrangement simplifies the order and succession of the "Lower Carboniferous" strata, we use both nomenclatures in the annexed table of the Entomostraca that we have observed in Sir R. Griffith's specimens.

We have also seen other Carboniferous Entomostraca from Ireland, which have been kindly submitted to us by the Officers of the Geological Survey of Ireland.

I. From the "Carboniferous Limestone."

1. Meath (Map, Sheet 33/4); Clonalvy, near Naul. *Entomoconchus Scouleri.*

2. Meath (Sheet 27/1); Duleek. Light-grey limestone. *Cypridina primæva* (gregarious).

3. Dublin (Sheet 7/1); Oldtown. *Leperditia Okeni.*

4. Tipperary (20/2); Carrig-Church, about 2½ miles north-west of Nenagh. Dark-coloured Polyzoan Limestone, with Echinoderm fragments and Shells. *Leperditia subrecta.*

5. Limerick (Sheet 11/2); Ballynolan, near Pallaskenry. *Entomoconchus Scouleri.*

6. Limerick (10/4); Glenbane, near Askeaton (No. 4253 *a*). *Leperditia Okeni.*

7. Limerick (29/1); Rathkeale. Grey limestone with *Fenestella. Leperditia subrecta.*

8. Cork (76/3); Ballyvodock, about 2 miles south-west of Middleton. Grey fossiliferous limestone. *Entomoconchus Scouleri* (gregarious).

II. "Lower Limestone Shale."

1. Londonderry; Ballrascreen. Hard dark-grey shale, micaceous, full of small *Leperditiæ.* (Portlock's Collection.) *L. subrecta, L. Scotoburdigalensis,* and still smaller obscure forms.

Sir R. Griffith's Names of the Formations.	Formations according to the Geological Survey.	Localities.	Genera and Species.	Nos. in this Article.
Upper Carboniferous Limestone	....	Enniskillen, Leitrim..........	Cyclus	1**
Middle Carboniferous Limestone	....	Ballintrillick, Donegal (Shale) .	Leperditia subrecta	18, 22.
			L. Scotoburdigalensis ..	18, 22.
Lower Carboniferous Limestone	Upper Carb. Limestone?	Little Island, Cork	Entomoconchus Scouleri	1.
" " "	" "	Millicent, Kildare............	E. Scouleri............	1*.
" " "	" "	Laracor, Meath.............	E. Scouleri?	14*.
Carboniferous Slate	Lower Limestone Shales?	Granard, Longford (Limestone)	Bairdia curta	3.
" "	" "	Aghnaglogh, Tyrone (Shale) ..	L. subrecta............	11.
Yellow Sandstone	Lower Limestone Shales	Dromard, Londonderry (Shale)	L. subrecta............	6, 13.
			L. Scotoburdigalensis ..	6.
			Kirkbya annectens	6.
			Cythere, sp.	6.
" "	" "	Cullion, Londonderry (Shale)..	L. subrecta............	19.
" "	" "	Cultra, Down (Shale)	L. subrecta............	7,8,9,10,15.
			L. Scotoburdigalensis ..	7,9,10,15,21.
			L. impressa	7, 10.
			L. amygdalina	10.
			Kirkbya annectens	9, 10, 21.
			K. costata	8.
			Beyrichia bituberculata..	7.
			Cythere Rankineana....	7, 10.
			Cythere	10, 21.
			Cythere	7.
" "	Lower Limestone Shales?	Larganmore, Mayo (Shale)	L. subrecta............	12, 23.
			Kirkbya annectens	12.
" "	" "	Bunowna, Sligo (Limestone*)..	L. subrecta............	16.

* This is also referred to the "Carboniferous Slate."

2. Tyrone; Tinnaglogh. Soft grey shale. (Portlock's Collection.) *L. subrecta* and *L. Scotoburdigalensis.*

3. Fermanagh; Kesh. Dark-grey hard shale, full of Entomostracous valves. (Portlock's Collection.) *L. Scotoburdigalensis*; also *Beyrichia* and *Bairdia*?

4. Fermanagh; Clebby. Soft grey shale, with Bivalve Shells. (Portlock's Collection.) *L. subrecta.*

5. Wexford (42/2); Whitestown House, Drinagh, near Wexford. Dark-blue hard shale, with pyrites. (H. 4321.) *L. subrecta* and smaller obscure forms.

III. "Carboniferous Slate."

1. Cork (74/2); Glen near the city of Cork. Dark-grey schist, weathering brownish: a hardened cleaved shale, with small Brachiopods. *L. subrecta* (distorted).

2. Cork (65/4); Bilberry Hill, N.E. of Middleton. Purplish and rusty schist or hardened cleaved shale, with *Cypricardia*, Encrinital joints, and distorted Entomostracous valves. This schist lies between the "Old Red Sandstone" and real "Carboniferous Limestone" continuous with that of Little Island. This "Lower Limestone Shale" near Cork is 1000 ft. thick, and all cleaved into slate ("Carboniferous Slate"). *L. subrecta* and *L. Scotoburdigalensis* (distorted). These compressed schists, with elongated and otherwise distorted *Leperditiæ*, appear to be identical with some of the so-called "Cypridinen-Schiefer" of Germany. Shales with *Beyrichia arcuata* (?) distorted (from Granton and elsewhere) resemble other specimens of "Cypridinen-Schiefer." *Entomis* supplies the other so-called "Cypridinæ" of these Rhenish strata.

3. Cork (118/1); Relane Point, south side of Bantry Bay. Grey schist, with pyrites, and weathering rusty. Gasteropods, &c. This schist is probably 2000 or 3000 feet above the top of the "Old Red" beds. *Leperditia Scotoburdigalensis.*

4. Cork (67/2); Youghal. Drab schist, with an ochreous parting which is full of well-preserved Entomostraca. This is 500 feet above the "Old Red" beds, and 300 feet below the "Carboniferous Limestone." *L. suborbiculata* and *L. parallela.*

5. Cork (105/1); Coory Commane Mountain, on the east side of the Glen of Coomhōla, Bantry Bay. Grey schist, micaceous: a hardened squeezed shale, with small Bivalves. This specimen was from the middle of the "Coomhōla Grits," 1800 feet above the top of the "Old Red," and where these grits are 3000 feet thick. *L. Scotoburdigalensis* (distorted).

Mr. Joseph Wright, F.G.S., has sent us a piece of "Carboniferous Slate" from Shanbally, Cork, containing casts of a *Cythere* (indeterminable).

In the Museum of the Geological Survey, at Jermyn Street, we have seen the following specimens from the Lower Carboniferous rocks of Ireland :—

1. "Carboniferous Limestone," near Kildare. *Entomoconchus Scouleri* (gregarious).

2. "Lower Limestone Shales."

a. Fermanagh (Sheet 18, Nos. 3 & 4; and Portlock's 'Geol. Report,' pl. 24. fig. 13 *c*). Grey shale. *Leperditia subrecta* and *L. Scotoburdigalensis.*

b. Kilkenny (Sheet 31/4) ; south of Knocktopher, and about a mile west of Ballyhale. Argillaceous schist, containing *Rhynchonella pleurodon,* and having rusty facings and badly preserved casts of *Leperditia subrecta.*

X.—*Notices of British Fungi.* By the Rev. M. J. Berkeley, M.A., F.L.S., and C. E. Broome, Esq., F.L.S.

[Plate II.]

[Continued from vol. xv. ser. 3. p. 452.]

1104. *Agaricus* (Amanita) *lenticularis,* Lasch in Linn. 1827, No. 18.

Coed Coch, Oct. 1866.

A single specimen of this magnificent species, according exactly with a figure received from Fries, occurred last autumn in the plantations surrounding the gardens at Coed Coch. It is remarkable for the great development of the ring and the smooth pinkish-tan pileus.

1105. *A.* (Lepiota) *Friesii,* Lasch in Linn. 1828, no. 9.

Jedburgh, A. Jerdon, Esq.

1106. *A.* (Tricholoma) *saponaceus,* Fr. Ep. p. 35.

In woods. King's Cliffe, Sept. 1, 1865.

This occurred in great profusion and perfection. *A. graveolens,* Sow., which is quoted under *A. saponaceus* by Fries, is undoubtedly *A. gambosus,* as appears from the original drawing and the notes which accompany it.

1107. *A.* (Clitocybe) *pithyophilus,* Fr. Ep. p. 62.

In fir-woods. Coed Coch, Oct. 19, 1865.

1108. *A.* (Clitocybe) *trullæformis,* Fr. Ep. p. 68.

On the border of a fir-wood. Coed Coch, Oct. 27, 1865.

The rather distant gills, which are connected with veins and infundibuliform pileus, distinguish this species, which is not hygrophanous.

**A.* (Clitocybe) *inversus,* Scop. Carn. p. 445.

Several tufts of this species occurred late in the year at

Woodnewton, in a ditch at a distance from any fir-wood, exactly according with Sowerby's figure.

1109. *A.* (Collybia) *exsculptus,* Fr. Ep. p. 93.

On old oak stumps. Apethorpe, Norths.; Badminton. On turf. Ilford, Essex, C. E. Broome.

Allied to *A. dryophilus,* but tougher. The gills are sulphur-coloured and transversely striate.

1110. *A.* (Collybia) *protractus,* Fr. Ep. p. 97.

On the ground. Ascot, Nov. 22, 1865.

**A.* (Mycena) *pelliculosus,* Fr. Ep. p. 116.

On the ground. Hanham, C. E. Broome.

1111. *A.* (Mycena) *vitreus,* Fr. Ep. p. 111.

In woods. Bryn Tyrch, Caernarvonshire, Oct. 1865.

1112. *A.* (Omphalia) *gracillimus,* Weinm. Ross. p. 121.

In marshy ground, on decaying stems of vegetables. King's Cliffe, Aug. 18, 1865.

1113. *A.* (Entoloma) *griseo-cyaneus,* Fr. Ep. p. 145.

On lawns. Coed Coch, Oct. 1865.

1114. *A.* (Clitophilus) *popinalis,* Fr. Ep. p. 169.

On downs. Worthing, Oct. 1865, F. Currey, Esq.

A curious species, with a strong odour of new meal, and probably esculent. The pileus and flesh are of a greyish tint, the gills strongly decurrent, and the spores pink.

1115. *A.* (Clitophilus) *cancrinus,* Fr. Ep. p. 150.

In a grass-field. Apethorpe, Norths. Aug. 16, 1865.

Exactly agreeing with an original drawing from the Swedish Museum. Pileus of a very pale flesh-colour or whitish, at first umbilicate; gills distant, at first white.

1116. *A.* (Nolanea) *junceus,* Fr. Ep. p. 156.

In a wood near Pont Gyffyng, Caernarvonshire, Oct. 24, 1865.

Exactly agreeing with a drawing from Fries.

1117. *A.* (Hebeloma) *deglubens,* Fr. Ep. p. 173.

In woods. King's Cliffe, Aug. 18, 1865.

Exactly agreeing with a drawing from Fries.

1118. *A.* (Hebeloma) *hiulcus,* Fr. Ep. p. 175.

In woods. Fineshade, Sept. 1, 1865.

Allied to *A. rimosus;* but the flesh turns everywhere reddish when cut or bruised.

1119. *A.* (Flammula) *gummosus,* Lasch in Linn. 1827, no. 325.

On old stumps in the plantations round the Botanic Garden at Cambridge, Dec. 6, 1865.

1120. *A.* (Flammula) *carbonarius,* Fr. Ep. p. 186.

In fir-woods where the undergrowth had been burnt, at Ascot, Nov. 22, 1865.

This species, remarkable for its viscid pileus, squamulose

stem, and adnate clay-coloured gills, occurred in immense quantities at the above-mentioned locality.

1121. *A.* (Naucoria) *autochthonus*, n. s. Pileo obtuso, hemisphærico, ochreo-albo, sericeo, margine flocculoso; stipite tenui, flexuoso, sursum basique albo-lanato incrassato; lamellis melleis horizontalibus distincte dente adnatis.

On the naked soil. Woodnewton, Northe.

Pileus $\frac{1}{4}$ inch across; stem $\frac{3}{4}$ inch high, not half a line thick in the centre. Spores paler than in *A. furfuraceus*, ·00019 inch long (those of *A. furfuraceus* ·00022 inch long). It does not become pallid in drying, like that species, but is of an ochraceous white from the first. It is probably a very common species.

1122. *A.* (Naucoria) *escharoides*, Fr. Ep. p. 201.

On the bare ground. Apethorpe, Aug. 16, 1865.

Exactly the plant of Schæffer, t. 226.

Pileus campanulate, obtuse, slightly fleshy, umbonate or umbilicate, sometimes plane, hygrophanous, innato-squamulose, often venulose, tawny, at length pallid; veil white, evanescent; stem flexuous, nearly equal, clothed with white fibrils, pale, ringless, fistulose; gills broad, bright cinnamon, distant, fixed, acute behind, at length seceding; spores ·0006–·00065 inch long, of a pure ochre, not peroxidate. Brittle.

1123. *A.* (Galera) *aleuriatus*, Fr. Ep. p. 203.

On rotten sticks, &c. Coed Coch, Oct. 26, 1865.

An extremely pretty species, exactly according with a figure from Fries.

1124. *A.* (Galera) *mycenopsis*, Fr. Ep. p. 208.

In marshy ground, in a wood amongst *Sphagna*. King's Cliffe, Aug. 18, 1865.

Our plant belongs to a variety, mentioned by Fries, with adnate gills.

Pileus with the margin clothed with little white scales, the remains of the veil; stem slightly furfuraceous above; gills adnate, not merely fixed with a tooth.

The species occurred also in Oct. at Pont Gyffyng, between Bettws and Capel Curig, and near Lake Idwell, where *Ag. semilanceatus* was abundant, with pallid gills entirely devoid of spores.

1125. *A.* (Galera) *paludosus*, Fr. Ep. p. 209.

In marshy ground in a wood, amongst *Sphagna*. King's Cliffe, Aug. 18, 1865.

1126. *A.* (Hypholoma) *hydrophilus*, Bull. t. 511.

In woods, &c. Not uncommon in England. Coed Coch, Oct. 23, 1865.

This species was described in the 'English Flora,' but was by some accident omitted in the 'Outlines of English Botany.'

The veil, though fugacious, at once distinguishes it from some other species with which it might easily be confounded.

**A.* (Psathyra) *corrugis*, P., b. *gracilis*, Fr. Ep. p. 231. *A. pellospermus*, Bull. t. 561. f. 1.

On the ground. Woodnewton, Aug. 20, 1865.

1127. *A.* (Panæolus) *leucophanes*, n. s. Pileo campanulato, obtuso, viscido, sicco nitido, innato-sericeo albo, hic illic subochraceo; margine appendiculato; stipite sursum attenuato, albo, fibrilloso, particulis farinaceis sparso, transversim subundulato fistuloso, lamellis adnatis e pallide griseo-carneis atris, margine albo.

In grass-fields. King's Cliffe, Aug. 29, 1865.

A very pretty species, allied to *A. separatus*. Pileus ¾ inch across; stem 2 inches high, about 1 line thick in the centre; spores ·00037 inch long, somewhat cymbiform.

PLATE II. fig. 1. *A. leucophanes* and vertical section, nat. size.

1128. *Cortinarius* (Inoloma) *camphoratus*, Fr. Ep. p. 280.

On the ground in woods. Fineshade, Sept. 1, 1865.

**C.* (Inoloma) *Bulliardi*, Fr. Ep. p. 282.

In woods. Fineshade, Sept. 1, 1865.

Remarkable for its bright-red mycelium.

1129. *C.* (Hygrocybe) *decipiens*, Fr. Ep. p. 312.

In woods. Fineshade, Sept. 1, 1865.

1130. *C.* (Hygrocybe) *Junghuhnii*, Fr. Ep. p. 314.

In woods. King's Cliffe, Aug. 30, 1865.

Spores ·0003 inch long.

1131. *Russula cyanoxantha*, Fr. Mon. Hym. Suec. p. 194 (*A. cyanoxanthus*, Schæff. t. 93).

In woods. Fineshade, Northamptonshire, Sept. 1, 1865.

1132. *R. veternosa*, Fr. Ep. p. 354.

On the ground. J. Fryer, Esq., Chatteris.

A single specimen only of this species was sent from the above locality to the 'Gardener's Chronicle' office to be named.

1133. *R. lactea*, Fr. Ep. p. 355.

On the ground. King's Cliffe, Aug. 29, 1865.

The thick, distant gills and milk-white pileus characterize this fine species, which is probably widely diffused.

1134. *Cantharellus radicosus*, n. s. Pusillus; pileo profunde umbilicato, floccoso, nigro; stipite pallido, radicante; hymenio candido; lamellis angustis.

On the bank of a gravel-pit. Ascot, Nov. 22, 1865.

Pileus ¾–1 inch across, deeply umbilicate, dark brown or black, rough with radiating flocci; stem rooting, deeply pallid; gills narrow, white. Two or three pilei often grow from the same obconical root, which is white and spongy.

This agrees in some respects with *C. carbonarius,* Alb. & Schw., which is said to be a variety of *C. umbonatus,* and must therefore be very different from the present species. *C. anthracophilus,* Lév., appears more nearly allied, but has a very different habit.

1135. *C. crispus,* Fr. Ep. p. 369.

On branches of beech. Jedburgh, A. Jerdon, Esq.

This very pretty species has occurred two years running. The colour of the pileus varies from a yellowish brown to white.

**Marasmius Stephensii,* Bk. & Br., Ann. of Nat. Hist. ser. 2. vol. xiii. p. 403. This is probably synonymous with *Marasmius terginus,* Fr.

1136. *M. caulicinalis,* Fr. Ep. p. 383.

On the ground, amongst leaves, in a fir-wood. Ascot, Nov. 22, 1865.

Pileus smooth, white tinged with ochre, at length sulcato-striate; gills adnato-decurrent, connected by veins.

Our plant seems paler in colour than that of Fries, but agrees in essential characters.

**Strobilomyces strobilaceus,* Berk. Outl. p. 236.

A specimen of this rare fungus was sent from Ludlow by the Rev. A. Bloxam.

1137. *Polyporus* (Anodermei) *cuticularis,* Fr. Ep. p. 458.

On trunks of trees. Burnham Beeches, C. E. Broome.

The hairs are curiously trifid at the apex; the spores yellow, as in *P. hispidus.*

1138. *P.* (Placodermei) *fulvus,* Fr. Ep. p. 466.

On decayed trunks of trees. Batheaston, C. E. Broome.

The specimen appears to have been gathered on a dead plum, and exactly accords with one on poplar, from Fries, in the resupinate state. It occurs on various trees, and is very distinct from *P. igniarius.*

1139. *P.* (Inodermei) *hirsutus,* Fr. Ep. p. 477.

On dead trunks. Orton Wood, near Twycross, Rev. A. Bloxam.

Certainly a very rare species in England, though one of the most common in warmer countries. The larger pores at once stinguish it from *P. versicolor, zonatus,* and *velutinus.*

**Craterellus cornucopioides,* Fr. Ep. p. 532.

As some doubt has been raised with respect to the specific difference of *Cantharellus cinereus,* it may be well to state that both were gathered at Burnham Beeches last autumn, and that the spores of the former are ·0006 inch long by ·00035, those of the latter ·0004 long by ·00015. In the former, moreover, the sporophores are forked above, and the spicules long and often less than four in number; in the latter the sporophores are obtuse and the spicules four.

**Sparassis crispa,* Fr. Ep. p. 570; Hogg & Johns. tab. 24.

Three large specimens of this noble addition to our flora occurred at Didlington, near Brandon, whence it was sent by Admiral Mitford.

1140. *Calocera striata,* Fr. Ep. p. 582.

On a prostrate trunk. Batheaston, March 10, 1846, C. E. Broome.

Exactly agreeing with Hoffmann's figure. A very rare plant, which has very seldom been seen by botanists. Spores ·0003 inch long, ·00025 broad.

1141. *Apyrenium armeniacum,* n. s. Receptaculo lobato, subgelatinoso, armeniaco, e filis ramosis, apice sporiferis, oriundo; sporis obovatis, enucleatis.

On oak sticks, bursting through *Corticium cinereum.* Charmy Down, near Batheaston, Oct. 1865.

Spores ·0003–·0005 inch long. This little fungus, though Tremelloid, has not the structure of *Tremella. Pyrenium lignatile,* Tode, is now pronounced by Tulasne to be a state of *Hypocrea rufa.* Our plant may possibly be a condition of *H. gelatinosa*; but, even should this prove to be the case, it is well in the meantime that it should be recorded.

PLATE II. fig. 2. Spores on their sporophores, highly magnified.

1142. *Reticularia applanata,* n. s. Effusa, tenuis, olivaceofusca; sporis olivaceis, echinulatis.

On the fallen trunk of a tree, the surface of which had been charred. Ascot, Nov. 22, 1865.

Resembling in habit *Licea applanata.* Surface reticulated as in *R. maxima.* Spores 4–7, in a fascicle, connate, echinulate, ·0005 inch in diameter.

PLATE II. fig. 3. *a.* part of the peridium, with the irregular flocci proceeding from it, magnified; *a'.* part of the peridium seen from above, stretching over the processes which run down from it, ditto; *b.* spores, more highly magnified, in groups and separate.

1143. *Trichia flagellifer,* n. s. Globosa, sessilis, metallica; floccis apice flagelliferis; sporis carneis.

On spruce fir. Badminton, Dec. 1865.

Perfectly globose, but fixed only by a small portion of the surface, which slightly projects, smooth, bay, reflecting metallic tints like a *Physarum*; flocci divided above two or three times; spores ·0003–·0004 in diameter.

Perfectly distinct from every other *Trichia* by the colour of the spores and metallic coat, in addition to the flagelliform threads.

PLATE II. fig. 4. *a.* single plant, magnified; *b.* threads, magnified; *c.* ditto, more highly magnified; *d.* spores, magnified.

[To be continued.]

XI.—*On the* Rhabdocœla. By E. Mecznikow*.

[Plate VIII.]

In his great work on the anatomy and developmental history of the lower marine animals, Claparède has expressed the opinion† that the *Rhabdocœla* must be divided into two groups corresponding with the two divisions of the *Dendrocœla.* He founds this opinion upon the fact that the genera *Convoluta* and *Macrostomum* possess two genital orifices. Although I can confirm this observation from my own investigations, and even add a third Rhabdocœlan with two genital apertures to those just mentioned, I must affirm that this peculiarity of the organs of generation, from its irregularity, cannot furnish any classificatory character either for the chief divisions or even for the genera. The following statements as to the sexual organs of some species of *Prostomum* may serve as a proof of this.

I will first call attention to the common freshwater form, *Prostomum lineare,* the sexual organs of which have already been investigated by Oscar Schmidt ‡ and Max Schultze §. In this animal the unequal development of the male and female organs in different individuals appears most remarkable: sometimes we meet with those which exhibit an aborted female apparatus along with a fully-developed male (Pl. VIII. fig. 1) or *vice versâ* (fig. 2). In the former we find a large unpaired testis (fig. 1 *t*), which communicates with a vesicle containing seminal masses (*v.s.*); this opens into another thick-walled vesicle, in which the zoospermia are converted into a compact mass. After this vesicle has received several currents of fatty corpuscles (*c. ad.*), which are evidently related in some way to the zoospermia, it is connected with the spinous apparatus which acts as the penis. In the individuals just described we find no poison-gland, and only few traces of the female organs, namely some isolated ovicells (*o.r.*); moreover in these individuals there is an isolated round vesicle, or *receptaculum seminis,* containing granules (*r. s.*).

In the other individuals of *Prostomum lineare* the male organs are in a rudimentary state, as the testis alone can be detected in them, whilst the two seminal vesicles have disappeared entirely. The female organs of such individuals, on the contrary, are completely developed. The ovary (fig. 2 *ov.*), a simple gland

* Translated by W. S. Dallas, F.L.S., from Wiegmann's 'Archiv,' 1865, pp. 174–181.

† Beobachtungen über Anatomie und Entwickelungsgeschichte wirbelloser Thiere, 1863, p. 16.

‡ Die Rhabdocœlen Strudelwürmer, 1848, p. 26.

§ In Carus's Icones Zootomicæ, tab. 8. fig. 16.

filled with ova, lies on the side of the body. Near it there is a pyriform uterus (*ut.*), which is continued into a vagina opening outwards. The yelk-stock is also to be seen as a long band-like structure; and at the inferior side of the body there is a very large double *receptaculum seminis* (*r.s.*), filled with zoospermia, the orifice of which I could not detect. Finally, the female individuals also possess a poison-gland, the efferent duct of which is combined with the spinous apparatus.

The organization of the genitalia of *Prostomum lineare*, as just described, does not precisely agree with the descriptions of these objects cited above. In the first place must be mentioned the difference in the distribution of the male and female organs in the same individual, both kinds of organs being represented as quite equally developed in one specimen in the figures of the above-mentioned writers—a circumstance which may probably be due to their having made their drawings from the observation of several (male and female) specimens. The second and more important difference between my description and those of Schmidt and Schultze is due to the fact that those *savants* regarded the uterus as the egg-shell, and therefore furnished the egg with a peculiar stalk (Schmidt), or with a still more peculiar micropyle (Schultze). In consequence of this misconception the above-mentioned authors have described *Prostomum lineare* as monoporous, and have not recognized it as an animal furnished with two genital apertures, which it really is. The other, less important differences between my description and that of the other observers may be seen by a comparison of the figures.

From the preceding statements it is clear that *Prostomum lineare* presents in a less degree the same phenomenon of incipient hermaphroditism which Claparède observed in *Convoluta*.

The peculiarities in the structure of the sexual organs of *Prostomum lineare* are by no means common to the whole of its genus, and do not even extend to the most nearly allied species. This is shown by a new marine species, also provided with a spinous apparatus, which I discovered in Heligoland, and therefore indicate as *P. helgolandicum*. The specific characters of this species (Pl. VIII. fig. 3), which is oval and furnished with comparatively large eye-points and cerebral ganglia, relate chiefly to the structure of the sexual organs. These are not so unequally distributed as in the previously described species; *P. helgolandicum* is perfectly hermaphrodite. The ovaries and yelk-stocks (fig. 3 *ov.* & *vit.*) are paired organs running along the two sides of the body; and besides these, we may distinguish a uterus (*ut.*) with a crown-like inner margin. Of the male organs I was able to observe the two symmetrically arranged seminal vesicles (*v. s.*) and the unpaired thick-walled vesicle

communicating with the spinous apparatus; the spine itself is connected with the poison-gland.

Besides these two *Prostomeæ* I have met with Claparède's *Prostomum caledonicum** on Heligoland, and observed its sexual organs. I have only to add to the accurate description of Claparède that the animal does not, as described, possess *one* seminal vesicle, but *three* of them (fig. 4 *v. s.*), of which two are situated upon the upper surface of the penis and the third near its point of aperture. I must also remark that these vesicles are not imbedded in the interior of the sheath of the penis, but outside of it.

II. Schmarda† has found in the standing and brackish waters of North America two Rhabdocœla with a terminal pharynx and eyes placed behind it (that is to say, with the characters of the genus *Prostomum*, according to former notions, when the proboscis was regarded as the pharynx); of this he has formed a distinct genus, *Acmostomum*, the representative of the family Acmostomeæ.

I found a marine species of this family on Heligoland. This pale-brown species, which measures 1·5 millim. (fig. 5), possesses at the anterior end a conical pharynx, which differs in form, and in the absence of the marginal papillæ, from the same organ of the Acmostomeæ described by Schmarda. Behind this there are two brown eyes, lying close upon the brain. The latter, which is of the usual construction, gives off two strong nervous stems from each side. The animal observed has the sexes completely separated; but unfortunately I have only found a male individual, the generative organs of which consist of several testes constructed exactly as in *Monocelis* (fig. 5 *r. s.*), and of a strong seminal vesicle (*v. s.*) furnished with a muscular efferent duct. The zoospermia with which the vesicle was filled are represented in fig. 5 A.

The species just described may very well be regarded as the representative of a peculiar genus; but I leave it for the present in the still imperfectly known genus *Acmostomum*, under the name of *A. dioicum*.

III. Under the name of *Alaurina prolifera*, Busch‡ has described an animal found by him only on one occasion, at Malaga, upon the systematic position of which he was in doubt. It was an elongated animal, with cilia and stiff hairs, and was met with in process of transverse division.

A Turbellarian larva, with its caudal extremity apparently presenting indications of a segmentation, described and figured

* Recherches sur les Annélides, Turbellaires, &c., pl. 5. fig. 5.

† Neue wirbellose Thiere; Erste Hälfte, p. 3, taf. 1. figs. 1, 2.

‡ Beobachtungen über wirbellose Thiere, p. 114, taf. 11. fig. 9.

by Claparède*, and found by him on the Scottish coasts, is evidently very nearly allied to the animal just described.

Both these animals were found in a sexless state, and therefore regarded as larvæ. Leuckart † remarks, upon the form described by Busch, "*Alaurina prolifera* is certainly a larval worm, although it may be doubtful to what group it belongs." The anatomical structure of the larva in question is very imperfectly described in the memoirs just cited. It was the more interesting to me, therefore, to meet with several specimens of an animal nearly allied to *Alaurina*, which I found, in August last, upon the surface of the sea near Heligoland.

All the specimens found were composed of four parts (Pl. VIII. fig. 6), of which the foremost was the longest, whilst the other three were nearly of equal length. The total length of the animal was $1\frac{1}{2}$ millim. The anterior part was furnished with a tactile proboscis, as in the animals of Busch and Claparède,—therefore with an apparatus which may be regarded as a group-character. Its pale-green colour distinguishes it from the rest of the body, which is citron-yellow, and covered with a dense coat of fine cilia, which are entirely wanting on the conical proboscis. The stronger vibratile hairs described by Claparède on his larva are not present in my animal; but, on the other hand, it bears a long seta at its posterior end, and this may probably be identical with those of *Alaurina prolifera*.

The cilia are inserted upon the isolable spherical epithelial cells. Under the skin the body is surrounded by a distinct layer of annular muscular fibres. Of the nervous system I have found no trace in my animal; but there is a pair of small black eye-points behind the proboscis. The eyes do not usually occur upon the three hinder parts of the body; once only have I seen a pair of such organs upon the last "segment."

The mouth is situated on the ventral surface, behind the eyes. It leads into a ciliated buccal cavity, which narrows and then leads into a pharynx (fig. 6 *ph.*) provided with strong muscles (nearly as in the *Mesostomeæ*). The intestine runs straight through the whole body; I could not observe its posterior orifice (anus), any more than Claparède, whilst Busch describes his *Alaurina* as an animal provided with an anus. I believe that these characters in my animal are very similar to those of the *Microstomeæ*, in which I have likewise sought in vain for an anus. In *Microstomum lineare*, under a moderate pressure, I always saw the contents of the intestine issuing only from the mouth. Do the Microstomeæ really possess no anus? and is

* Recherches, &c. p. 83, taf. 5. fig. 2.
† Göttingische Anzeigen, 1852, p. 867.

that which is described as such by previous observers perhaps only a torn place produced by division?

On the two sides of the body there are two very fine water-vascular stems (fig. 6 *r.a.*), the opening of which, however, I could not find.

The *Alaurina* observed by me is evidently not a larva, but rather furnished with hermaphrodite sexual organs, which are present in each "segment," and sometimes even occur in double number in one or more of the segments. The testes are numerous and distributed in the body (fig. 6 *t*), appearing like capsules containing the zoospermia. The male apparatus also includes a seminal vesicle of considerable size (*v. s.*), the efferent duct of which opens into a tubular penis (*pe.*) composed of chitine. The extremity of this is inserted into the male genital orifice, which is situated on the side of the body and often surrounded by a cutaneous projection.

Near each seminal vesicle there occurs an ovum furnished with a nucleus and nucleolus, which forms the female apparatus. I could not find the female genital aperture; but, as it can hardly be wanting (for the male orifice is too narrow to furnish room for both male organs during copulation), I am inclined to think that it is only present at the time of copulation.

As I have now described some of the peculiarities of organization of the animal observed, I may be allowed to draw one or two conclusions therefrom. In the first place, I must assert that the parts of which the body is composed are by no means buds which would subsequently separate. This opinion is founded upon the fact that the whole animal possesses a common proboscis, mouth, and intestinal canal, as well as common aquiferous vessels; and I have never seen traces of these parts upon the segments when already sexually mature. Perhaps, however, the parts above interpreted as segments are to be regarded as the joints of an animal colony analogous to the Cestoda, as was urged upon me by Prof. Leuckart (who also first called my attention to the similarity of my Turbellarian to Busch's *Alaurina*).

As regards the systematic position of this worm, which I denominate *Alaurina composita*, I think that, together with the animals observed by Busch and Claparède, it forms a distinct family in the neighbourhood of the *Microstomeæ*, to which the *Alaurinæ* are more or less related from the resemblance in the structure of the sexual organs and intestine.

If my statements are correct, Max Schultze's system cannot remain quite unaltered, inasmuch as he describes the *Microstomeæ* as Arhynchia, which, however, will not do for the *Alaurinæ* which are furnished with a proboscis. Perhaps the *Microstomeæ*

and *Alaurinæ* are to be regarded merely as families of the Rhabdocœla, a view which has already been expressed by Leuckart, at least with regard to the former. The peculiarities of the sexual organs and fission can no longer be accepted as ordinal characters, since we have become acquainted with the proliferous *Catenula* and the Rhabdocœla with the sexes separate.

XII.—*On the Reproduction and Embryogeny of the* Aphides. By M. Balbiani*.

Of the questions relating to the generation of animals, one of those which are still most open to discussion is that of the mode of propagation of the viviparous Aphides. According to the ideas which observers have formed of the nature of the reproductive organs of these insects, their multiplication has been referred sometimes to the phenomena of alternate generations, sometimes to those of parthenogenesis or virgin-generation. As to the opinion which consists in assuming an androgynous condition in these animals, which is still maintained by some authors, as well as by Leeuwenhoek, Cestoni, and Réaumur, it rests upon a mere hypothesis which has not yet received its material demonstration by the detection of the male element in the viviparous Aphides.

It is this last view that I propose to defend here by bringing forward the positive proof for which science has waited since the time of the illustrious observers who first pronounced in favour of the hermaphroditism of these creatures. I propose, in fact, to show that this state is the normal condition of the Aphides throughout the viviparous period of their existence, and I shall also show in what manner the separation of the sexes is effected in them, when, under the influence of certain determinate conditions, their mode of reproduction reverts to the law common to the generality of species of animals.

The evolution and physiological function of the generative organs commencing at a very slightly advanced period of the embryonic life of these insects, and their history being, so to speak, inseparable from that of the development of the ovum itself, I shall have to trace faithfully, though concisely, the principal phases of this development. It is by following this course in my observations that I have succeeded in coming to an understanding of this question which has been so long in debate. This investigation will also, as we shall see, reveal some remarkable facts which I regard as of high interest with respect to the origin of the male and female generative elements,

* Translated from the 'Comptes Rendus,' June 4, 1866, pp. 1231–1234.

and their relations to the rest of the organism. But, in the first place, it is necessary to give an idea of the structure presented, according to my observations, by the organ in which the embryo originates—that is to say, the female sexual apparatus or ovary of the viviparous Aphides.

This apparatus consists, as in most other insects, of a variable number of tubes or sheaths, each of which is dilated at its anterior extremity into a terminal cell or chamber containing a group of small cells. One of these occupies the centre of the group and is entirely surrounded by the others. This central cell is the most important of all; for it represents the generative element or the mother cell of all the ovules in each sheath which are destined to become converted into embryos. These ovules originate in the form of true buds, which, separating successively from the central cell, appear at the bottom of the terminal chamber before passing into the upper part of the sheath. The peripheral cells, attached to the former by hollow pedicles, are its nutritive cells, its sole function being to emit incessantly new ovular buds.

At the moment when the ovule penetrates into the ovarian sheath, it clearly presents a germinal vesicle and spot. A delicate filament still attaches it for a time to the mother cell; but this union is soon broken, and the ovule remains completely isolated in its chamber. It is generally at this moment that the modifications which are to lead to the formation of the embryo commence in the ovum. The germinal spot first disappears, and is soon followed by the vesicle which contained it. During this period some nuclei, at first rare, have made their appearance on the surface of the vitellus, and condensed around them the transparent homogeneous substance of which it is composed. By this means are formed the first blastodermic cells. No membrane as yet surrounds them. The rather wide intervals separating them at first are quickly filled up by the appearance of new nuclei and cells. The ovule is thus finally clothed over the whole of its surface by a continuous layer of cells arranged in a single series and pressed against each other. At this period they all present a very recognizable proper envelope.

While the blastoderm has thus been completing its formation, the ovum has increased in size and passed from a spherical form to that of an elongated oval; at the same time it has descended a little in the interior of the ovarian sheath. The central vitelline mass enclosed in the cavity of the blastoderm has lost its homogeneous aspect and become penetrated by fine colourless granulations. Soon afterwards an orifice is formed at the posterior pole of the blastoderm*, in consequence of the separation at

* I give the name of posterior pole of the blastoderm or ovum to the

this point of the cells composing it; and the internal granular mass projects through this orifice. We then clearly perceive, either directly or by means of reagents, that the whole inner surface of the blastoderm is lined with a delicate membrane which extends like an envelope round the central vitelline mass.

It is this membrane, with a portion of its contents, that projects, as just stated, through the orifice at the posterior extremity of the blastoderm. This hernial portion attaches itself to the corresponding epithelial cells of the ovarian chamber, which are hypertrophied, and becomes as it were engrafted upon them. When this connexion is established, the vitelline vesicle becomes constricted in the interior of the cavity of the blastoderm like a cell in process of division, and then separates into two juxtaposed secondary cells,—the posterior adherent to the epithelium of the chamber, the other, or anterior, being completely free in the above-mentioned cavity. I have sometimes succeeded in detecting a very pale granular nucleus in the posterior vesicle, and less distinctly in the anterior one; they, therefore, present all the characters of true cells. These vesicles or cells are to be the origin of the male and female generative elements of the future animal—that is to say, of the ova on the one hand, and the spermatic cells on the other. In fact, by a phenomenon of germination which I cannot describe here in detail, each of them becomes covered at its surface by a generation of small cells, which, when once produced, increase in size and continue to multiply on their own account. From this results the formation of two very distinct cellular groups placed side by side in the cavity of the blastoderm. The group produced by the herniated vesicle engrafted upon the exterior epithelium represents the male element, and will give origin to the fecundating corpuscles; that which originates from the free vesicle in the interior of the ovum is, on the contrary, formed by the totality of the female elements—that is to say, the generative cells of the future ovules, surrounded by their nutritive cells. This latter group soon subdivides into a certain number of secondary groups, corresponding with that of the ovarian sheaths which are subsequently to be formed. The cells which compose it remain always transparent and colourless, and are also smaller than those of the first group, the cells of which, on the other hand, are soon permeated by numerous small green or yellow granulations, which enable them to be recognized with the greatest facility*. The generative vesicles of the two sexual masses be-

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extremity which is directed towards the external sexual orifice, and that of anterior pole to that which looks towards the terminal chamber of the ovarian sheath.

* This yellow or green mass, which is met with in most Aphides at all

have in a very different manner in the sequel of the development: that which has given origin to the female elements disappears immediately afterwards, whilst the vesicle which has generated the male or spermatic elements, far from disappearing, continues its development, often becomes very large, and after forming connexions with the female generative apparatus, constitutes a reservoir for the fecundative corpuscles—becoming, in fact, a true seminal vesicle for this hermaphrodite apparatus.

When the curious phenomena just described summarily have terminated, the embryonic development, properly so-called, has not yet commenced. We may, indeed, observe that the cells of the blastoderm have multiplied at the anterior pole so as to produce a very considerable thickening there; but this modification is not followed by the formation of any new part. This thicker layer, in fact, soon gradually diminishes, and is at last entirely effaced*.

XIII.—*On the Reproduction and Embryogeny of the* Aphides. By M. Balbiani. (Second Note.)†

In the viviparous *Aphides* the blastoderm assists to a certain extent in the formation of the embryo, but its part is exclusively limited to the production of the laminæ which complete the cephalic extremity in front. All the rest, on the contrary, results from an entirely new part superadded to the blastoderm.

The first phenomenon which denotes the commencement of embryonic development is a budding forth of cells upon one of the halves of the circumference of the aperture (of which I have already indicated the purpose and mode of formation) at the posterior pole of the blastoderm. The result of this budding is the production of a cellular lamina, which gradually rises from the margin of the preceding aperture into the interior of the ovum, folding back against the inner wall of the blastoderm, which it appears in some degree to double for a certain extent. When arrived within a short distance of the anterior pole, it folds inwards, inversely to its former direction, as if to descend again towards the aperture which was its point of departure, but without passing, at least at this time, the middle of the ascending

periods of embryonic development and even after birth, has been described sometimes as serving for the nutrition of the embryo (*pseudo-vitellus* of Huxley), sometimes as a plastic mass destined for the formation of the vegetative organs (Leydig).

* This transitory production of the blastoderm of the Aphides is probably the analogue of the "primitive cumulus" described by Claparède as preceding the formation of the embryonal rudiment in the ova of the Spiders.

† Translated from the 'Comptes Rendus,' June 11th, 1866, pp. 1285–1289.

branch. This curved lamina, produced in this way by a budding of the blastoderm in the interior of its own cavity, is nothing but the embryonic rudiment or primitive streak, less the anterior part of the head; in fact the ascending branch represents the whole of the ventral cephalothoracic wall, destined to bear the buccal and locomotive appendages, and the descending branch the ventral wall of the abdomen. As to the elements destined to form the anterior wall of the head with its appendages, or the antennæ, these are, as I have just stated, the only ones which result from a transformation of the blastoderm. For this purpose the latter becomes thickened in the region corresponding with that against which the ascending or cephalothoracic branch of the primitive streak is applied in such a manner as to surround like a hood the base of this branch, with which this thickened part is continued through the orifice of the posterior pole. In all the rest of its extent the blastoderm becomes transformed into a delicate membrane, which envelopes the embryo as it were in a sort of sac, which isolates it from the ovarian chamber.

At this period of its evolution the embryonal streak therefore presents in its totality the form of an S, of which the inferior curvature represents the cephalic hood, the superior curvature the rudiment of the abdomen, and the intermediate branch the combined rudiments of the head and thorax.

The primitive streak divides into two longitudinal halves by the formation of a furrow upon each of its faces. These two symmetrical halves, which represent the axes of the two halves of the body, and betray the bilateral type of the animal, are the germinative tuberosities (*Keimwülste* of the German embryogenists). Their formation is one of the earliest phenomena in the evolution of the *Aphides*; for it takes place *pari passu* with the formation of the primitive streak, and consequently long before the appearance of the zonites and their appendages. As to the other principal embryogenic phenomena, such as the formation of a reflected superficial lamella (the *Faltenblatt* of Weismann), that of the primitive parts of the head, the division of the germinative tuberosities into transverse segments or zonites, the appearance of the cephalic and thoracic appendages, &c., I can only mention them here, leaving all that relates to these different points of embryonic evolution to the memoir in which I propose to treat *in extenso* the subject of which this note gives a summary.

In proportion as the primitive streak penetrates into the interior of the ovum, the sexual masses follow it in its movement, and place themselves against the inner face of the upper reflected or abdominal portion of this streak. At this period nothing yet exists resembling a visceral cavity, the streak, as in all the Arti-

culata, containing only the elements of the head and of the inferior wall of the body. The sexual masses are therefore, in point of fact, completely naked and outside the embryo. But already we can see that the embryonic cells arrange themselves in parallel series directed towards the extremity of the abdomen, to form excretory ducts, destined to place them in relation with that region.

Development continuing under these conditions, the embryo enlarges, and with it the whole sexual apparatus; the parts already existing become completed and perfected, the mouth and anus are formed, and the digestive tube becomes visible at its extremities. It is at this point that a phenomenon occurs equally simple in its mechanism and important in its results for the further progress of the development of the Articulata, namely the reversal of the mode of rolling of the embryo. This reversal, which is not always effected by means of exactly the same process in all these animals, takes place in the *Aphides* by an actual backward summerset executed by the embryo in the interior of its cell. In consequence of this change of position the head, which at first was in relation to the posterior part of the cell, arrives at the anterior part, while the ventral surface, at first turned inwards, now looks outwards, and is placed immediately under the envelope of the egg. By the same act the abdomen is transferred to the dorsal side, and rises, like a sort of tail to the embryo, as far as the posterior part of the head, leaving between it and the cephalothoracic rudiment a space, the greater part of which is occupied by the mass of the generative organs. In this new position all that is necessary is that the embryo should complete itself behind by the formation of a dorsal wall, in order that these organs may be enclosed in the cavity of the body quite naturally and without any new change of position.

The closure of the hinder part of the body is effected by the simple growth of the ventral arches towards the dorsal region, and their fusion in the median line of the latter.

If we endeavour at this period of development to understand the arrangement of the hermaphrodite apparatus of the viviparous *Aphides,* we find the primitive common mass of ovarian cells divided into two groups, symmetrically placed in the posterior part of the body, and each of these groups formed of a small number of cellular masses, each of which possesses a proper envelope. In these we easily recognize the terminal chambers of the ovarian sheaths, with their contents, consisting of small transparent cells. The male organ is likewise divided into two parts, arranged, in the form of two cords of variable form, on each side of the digestive tube, within the ovaries,

above which they rise more or less. The whole mass of these organs, the green colour of which being often very intense immediately catches the eye, is composed of large oval or polyhedric cells, the characters of which I shall describe further on, in speaking of the formation of the seminal corpuscles. A very delicate envelope extends itself round each of them, and is continued to the posterior part in an attenuated process, which loses itself upon the sides of the rectum, and probably represents an excretory duct. As the neck of the seminal vesicle may likewise be followed into this region, it is probably there that the union of these ducts with the spermatic reservoir is effected. As to the seminal vesicle, it is formed by a sac of considerable size situated on the median line above the intestine, with its fundus sometimes advancing nearly to the middle of the body. Its wall is formed by a simple structureless membrane, a true cell-membrane, of such delicacy and transparency that in most cases its presence is betrayed only by the seminal corpuscles and coloured granulations composing its contents—which explains how it has remained undetected by all observers. The seminal vesicle terminates by a very slender duct, which represents its neck, and which I have been able to trace to the point of union of the two ovarian tubes, where it is probably inserted.

It remains for me, in conclusion, to say a few words about the spermatic corpuscles and their formation. This commences very early; for all the embryos of the viviparous *Aphides* at the moment of their birth contain new generations in course of development. Still more, it is not rare to find the spermatic reservoir, to the early formation of which I have adverted above, already filled with seminal corpuscles before there is any trace of an embryo in the ovum. These corpuscles are formed, as I have already stated, in the large coloured cells which constitute the mass of the two organs situated in the vicinity of the ovaries. At the moment of their appearance these cells contained only a homogeneous and colourless substance; but as they enlarge they become penetrated by fine granules, which give them the green or yellowish-green colour presented by them in most *Aphides*; at the same time their contents become converted into a multitude of little daughter cells, furnished with a membrane and a nucleus: these are the cells of development of the spermatic elements. They are, in fact, soon replaced by innumerable small dark corpuscles of 0·001–0·002 millim. in diameter, which, under a strong power, appear like minute *Amœbæ*; but their form does not change under the microscope. The large mother cells have then lost their transparency and their green colour, and become opaque and brownish; they are easily disintegrated, breaking up into a sort of powder after the destruction of their

enveloping membrane. In many *Aphides* these Amœboid corpuscles undergo a further degree of evolution by their transformation into small unequal bacilli, which are straight or diversely flexuose, immobile and colourless, and 0·005–0·020 millim. in length. We might easily be led to regard them as a parasitic vegetable production, if we had not before our eyes all the successive phases of the transformation of these elements. Moreover their rapid solubility in alkaline solutions constitutes a character which differentiates them completely from the microscopic *Oscillatoriæ*, with which they present the greatest resemblance. Several times I have succeeded in seeing some of these corpuscles in the ovarian tubes, or forming small groups at the bottom of the terminal chamber of the ovigerous sheaths.

In the third and last part of this memoir I shall investigate the phenomena of reproduction in the oviparous *Aphides*, and show how these are related to the viviparous generations which preceded them.

MISCELLANEOUS.

On the Metamorphoses of the Marine Crustacea. By M. Z. Gerbe.

The author gives the following summary of the conclusions to which his investigations have led him:—

1. The larvæ of the species belonging to the genera *Maia, Pisa, Platycarcinus, Cancer, Xantus, Gonoplax, Portunus, Porcellana, Palinurus, Homarus, Callianassa, Crangon, Athanas, Palæmon, Mysis, Ione,* and very probably those of many other genera, undergo, immediately after their birth, a first moult, which gives them a form different from that which they possessed in the egg.

2. None of the marine Crustacea of the division Podophthalma, or of the Edriophthalma, which I have observed has its organization complete at birth or possesses forms by which it might be referred to the species to which it belongs, and all are furnished with transitory appendages for natation, which give them a locomotion different from that which they will have in the perfect state: these appendages persist until the fifth or sixth moult, and become atrophied in position without falling off.

3. It is only at the fifth moult in some, and at the sixth in others, and after having undergone modifications at each moult, that the general form of the adult and the external organs are complete. To these transitory external forms, so different from those of the perfect animals, and becoming modified at each moult, are due a multitude of false species and genera and doubtful families *, and even, as regards the larvæ of the *Palinuri*, an entire order to be eliminated.

* The family of the Erichthidæ, in the order Stomapoda, appears to me to be chiefly founded upon Crustacea in the larval state.

4. However the larvæ of various species of Crustacea may resemble each other in external form, nevertheless in the arrangement, the form, and the number of the spots of the skin and intestine, and especially in the number and conformation of the provisional appendages which adorn the extremity of the last segment of the abdomen, they present definite characters which enable us to say to what species any particular larva belongs.

5. The stomach of the larvæ of the marine Crustacea presents no solid piece adapted to the grinding of food ; it is merely furnished on its inner face with rigid *spinules* arranged in rows, and with vibratile cilia like those found in the stomachs of a great number of the lower animals. These cilia communicate an incessant movement of rotation to the organic molecules upon which the animal feeds.

6. In all larvæ of Crustacea, the liver, at first reduced to two simple cæca, one on each side, is manifestly a diverticulum of the intestinal tube, with which it has wide communications ; by ramifying, it forms a hollow tree, at the base of which we may see oscillating the vitelline globules which the umbilical vesicle pours into the pyloric portion of the intestine.

7. The marine Crustacea, however the respiratory functions may be ultimately performed, all have a tegumentary respiration in the larval state.

With the exception of the Lobsters, which, when first hatched, have a rudimentary branchial apparatus quite unfit to perform any functions, the larvæ of the other genera of Crustacea enumerated above are absolutely destitute of this apparatus ; some, indeed, do not present any traces of it until after several moults.

8. The want of the function of branchial respiration necessitates a radical difference between the circulation of the individual in the larval and the individual in the perfect form—that is to say, having acquired branchiæ. In all the larvæ of *Maia, Porcellana, Crangon, Palæmon, Palinurus, Homarus, Cancer,* &c., the blood which the arteries have distributed to the different parts of the body returns *entirely, directly to the heart,* and this condition persists for a considerable time. It is only after the third moult, in the most perfect larva of the species inhabiting our seas—that of the Lobster—that a few globules are diverted from the original general circulation to penetrate into the nascent branchiæ.

9. All the arteries open directly into the venous passages by an aperture more or less bevelled and more or less dilated into a trumpet-like form.

10. In some larvæ the abdominal artery may present a sort of sphincter in its course, at some distance from the central organ of circulation ; this, by contracting, temporarily suspends the flow of blood to the hinder parts*.

* This remarkable peculiarity exists not only in the larvæ of the Lobsters, as already indicated, but also in those of the *Porcellanæ*. It is even probable that it will be found in many species, and perhaps in all ; for when we observe the circulation in the last segment of the abdomen of larvæ of *Cancer, Carcinus, Palæmon,* &c., interruptions are perceived in it.

11. Although the transitory spines which arm the thorax of some species do not receive any arterial branch, a complete circulation is established in their cavity. Some of the globules which the venous lacunæ convey to the heart make a digression into these transitory appendages, traverse nearly their whole length, and return by a parallel course into the lacuna from which they started.

12. The central nervous system of the larvæ of Crustacea presents differences in its arrangement and form from that of the perfect individual; and the development of each of the medullary nuclei which constitute the ganglionic masses is in relation to the development of the organs to which these nuclei correspond.

13. Lastly, no larva of any species of Crustacea presents traces of the generative apparatus.—*Comptes Rendus*, May 7, 1866, pp. 1024–1027.

On the Mi-lou *or* Sseu-pou-siang, *a Mammal from the north of China, which forms a new Section in the Family* Cervidæ. By A. Milne-Edwards.

Father David, a missionary at Pekin, has sent to the Museum at Paris a zoological collection containing skins of the *Mi-lou*, a large species of stag, which is regarded by M. A. Milne-Edwards as a completely new form.

In its general aspect, in its coat, its clumsy gestures, and the mode in which the male carries his horns, it has a certain resemblance to the Reindeer. It approaches the true *Cervi* by the possession of a naked muffle and in the anatomical characters of the skull; but it is distinguished from all known Cervidæ by the direction and mode of ramification of the horns, and also by the structure of the tail.

The horns present no basal anterior antler, but they are greatly developed and much branched. The processes of the frontal bone from which they originate are larger than in the common stag. The beam is thick, and, at a considerable distance above the burr, gives origin to a long posterior branch, which is directed almost horizontally backward, so as nearly to touch the back of the animal; this branch is almost as thick as the *perche*, and bears on its subterminal portion several antlers arranged upon its outer margin and very close together, so as to form a sort of palmation slightly resembling that of the brow-antler of old reindeers. The *perche*, instead of being regularly curved, is twisted into an S-like form, and bears two large antlers directed backwards and inwards; it terminates in a fork; lastly, all the upper part of the horn is armed with a series of large tubercles, several of which are so much developed as to form little accessory antlers on the outer margin. The female has no horns.

The coat of these animals is rough, brittle, very thick, and of a uniform yellowish-grey colour, except on the median line of the back and chest, where there is a black band.

The tail, instead of being short and thick, is very long, and fur-

nished with long hairs towards the end; these sometimes descend beyond the heel, as in the ass.

According to M. David, the Chinese often give the *Mi-lou* the name of *Sseu-pou-siang*—that is to say, *the four* (characters) *which do not agree*, as they consider that the animal resembles the stag in its horns, the cow in its feet, the camel in its neck, and the mule or the ass in its tail. The author considers the characters of this animal to be so peculiar that it forms a new generic group, and he gives it the name of *Elaphurus Davidianus*.

The *Mi-lou* is of the size of a large stag; an adult male received by the Museum measures 1·30 metre to the withers; and larger individuals are often seen. The animal lives in herds in the imperial park at some distance from Pekin; it has been there for a long time; but the Chinese do not know how or at what time it was brought there. M. David thinks that the reindeer spoken of by Huc, in his 'Voyage en Tartarie,' as living in herds beyond the Koukou-Noor, towards 36° N. lat., may have been identical with the *Mi-lou*.—*Comptes Rendus*, May 14, 1866, pp. 1090–1092.

On the Pleuronectidæ of the Genus Zeugopterus, *and the Structure of their Branchial Cavity.* By J. Steenstrup.

In a monograph published in 1835 upon the Pleuronectidæ of the Sound and the Cattegat, M. Gottsche established several new genera which have not in general been accepted by zoologists. One of these genera, *Zeugopterus*, was characterized by the author as presenting a union of the anal fin to the ventrals by a fold of skin starting from the last rays of the latter. M. Kröyer, in his 'Danish Fishes,' has rejected this genus, as being founded upon a character of secondary importance, which can only be regarded as specific. M. Steenstrup agrees with Kröyer as to the value of the character, but nevertheless retains the genus *Zeugopterus*, because the character in question is never isolated, but always presents itself in connexion with others. The most important of the latter is a constant deviation either of the anal or dorsal fin towards the blind side—a deviation which cannot but exert some influence upon the mode of natation of the animal. Moreover the scales of the *Zeugopteri* are roughened with little teeth, and both the outline of the body and the coloration appear to present certain peculiarities common to all the species. But the most evident proof that the group *Zeugopterus* really forms a well-marked natural division, is the discovery by Steenstrup of a very remarkable anatomical peculiarity which is not exemplified in any other Pleuronectid. Thus in the *Zeugopteri* the vertical osseous partition which separates the two branchial cavities from each other is perforated by a large aperture in such a manner that the water can pass freely from one branchial cavity to the other. The physiological bearing of such an arrangement seems very problematical.—*Oversigt, &c., Danske Vidensk. Selsk.* 1865, p. 95; *Bibl. Univ.* May 1866, p. 79.

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XIV.—*Memoir on a new Parasitic Crustacean belonging to the Order* Lernæida, *forming a new Family.* By M. Hesse*.

The object of this memoir is to make known a new Crustacean, which, from the simplicity of its structure and the singularity of its habits, must, I think, excite the curiosity of naturalists. They will judge, from the description we shall give of it, of the embarrassment in which we could not but find ourselves, in the absence of all definite characters, to assign it a place in the classification of organized creatures.

§ 1. *Description.*

It is from 10 to 12 millimetres in length and 2 millims. in breadth; its body, covered with a parchment-like skin, is cylindrical and fusiform. It is essentially retractile in the direction of its length; and the segments of its abdomen, in consequence of the width of their inferior margin, can even become invaginated one within the other. It is divided into *five thoracic and six abdominal segments.*

Seen from the back, the *head* terminates in a rounded point, and presents in the middle a single eye, which, under different degrees of incidence of light, exhibits a play of colours varying from red to blue.

The *thoracic segments* are not very distinct, with the exception of the first two, which are easily recognized. The others are merely indicated by lateral depressions, especially when this part is tumefied by the accumulation of eggs; they increase in depth and width as they approach the base: the last, in particular, is much larger than the rest, is rounded laterally in the middle, and then contracts at its junction with the first *abdominal segment.*

* Translated by W. S. Dallas, F.L.S., from the 'Annales des Sciences Naturelles,' série 5. tome v. pp. 265–279.

The abdominal segments, when in their normal state (that is to say, neither much contracted nor much extended), are perfectly distinct from each other; they decrease in depth and width from the base to the apex, and are nearly square, being only a little narrower above than below. The last, or sixth, does not at all resemble the others in its form, which is nearly that of a shield, widened at its base, slightly emarginate at the sides, and terminated by two obtuse points furnished with a few hairs. Seen in profile, they show between them a cavity in which the anal orifice opens. However, these forms, which are well marked when they are in their normal state, are extremely variable and become considerably modified according to circumstances.

The *head*, seen in profile, has the frontal margin truncated at the apex and rounded and bent downwards at the sides. Upon it we perceive the antennæ, which are thick, short, cylindrical, and composed of two or three joints, terminated by divergent hairs. Starting from the antennæ, the outer margin of the cephalic envelope descends obliquely in a straight line to go to the superior angle formed by the inflation presented by the orifice of the œsophagus.

Between these two points is the *buccal orifice*, which is placed in the centre of a circular platform slightly hollowed in the middle. This apparatus, which is very complicated, presents the following arrangement:—Immediately below the antennæ, and at the sides of the epistome, there are two pairs of footjaws, which are solid, pectinated, and terminated by a hooked claw; then follows, in the middle, the buccal aperture, composed of a conical proboscidiform tube, which issues from and returns into a cavity formed in the centre of the platform. This tube, which is constructed of a very firm, but very delicate and transparent, membranous tissue, receives its impulsion from two pairs of footjaws, one superior and one inferior, which keep it extended or contracted according as this organ issues from or re-enters the cavity destined for its reception. When the tube is entirely out, we may perceive in its interior a conical appendage, rounded at the end, ascending and descending frequently, like the piston in the chamber of a pump: this is really the *mouth* with its mandibular armament.

The latter is formed of two pairs of footjaws, which are denticulated and trenchant, and furnished with a corneous substance; these, by applying themselves together, can seize and triturate objects. They are, moreover, surrounded by a soft and mobile *labial margin*, which seems to cover them when necessary; lastly, within these organs we see some mandibular palpi, completing this system, which may be employed, according to circumstances, both for suction and mastication.

The whole of this apparatus is strongly attached to the interior by very apparent muscular ligaments, by means of which it is continually issuing from and returning into the proboscis.

Lastly, we also see beneath this proboscis—that is to say, at the base of the buccal apparatus just described—a pair of very strong *footjaws,* composed of three joints, and terminated by a strong, flat, lamellar, and denticulated claw, constructed to dig into or cut objects. These footjaws are curved inwards, so as to be able to reach or even to pass the apex of the buccal orifice, upon which they lower themselves in case of necessity.

We have also remarked that the eye participates in the movement to and fro which causes the buccal apparatus to issue and return—an impulse which acts upon the tegumentary envelope in which it is fixed; we have likewise ascertained that it is capable of an incomplete rotation upon itself.

The *body,* which is very opaque, and, in consequence of its comparative thickness, conceals from sight the details of its interior organization, is surrounded throughout its whole extent by a transparent border, which follows all its outlines. Even with the aid of the compressorium we were unable to detect the movements of circulation, which nevertheless would have been very interesting; we ascertained only that the intestinal tube, which is very voluminous, especially at the middle of the body, passes directly from the œsophagus to the anus, and that the matters contained in it are black, thick, and syrupous; these issue readily from the body when it is touched rather roughly, and then, by spreading in the water, form a tolerably compact network, which remains for some time without dissolving.

It was only by infinite patience, and by taking advantage of an individual kept alive for more than a fortnight and reduced by abstinence until it was nearly transparent, that we succeeded in ascertaining the organization of the mouth and its evolutions. We had previously attempted in vain to detect them by means of the compressorium; its action upon these organs, crushing them, produced nothing but confusion, which prevented our continuing our observations. The lobes of the *liver* are very large, and are contained in the middle of the abdominal cavity. We could not detect the organs of generation. The *ova* are large, enclosed within the most spacious part of the thoracic region, and placed above the intestine while they are still contained in the oviduct. They are arranged in a chain in two or three rows, and form a considerable number of loops or sinuosities; their course may be detected, and is directed towards the orifices placed at the base of the last thoracic segment. When they are expelled from the body, they form a square flat mass; they are enclosed in a special envelope, and agglutinated together. They appear

to be excessively caducous; for I have never found them adherent to the body of the Crustacean, but always beside it in its retreat. But as they are contained in an enclosure from which they cannot escape, there is the less inconvenience, in the interest of reproduction, in the fact that they detach themselves so readily from the body of the female.

The *male* of this species is unknown.

The *embryo* resembles that of all the suctorial Crustacea: its body is oval, with the forehead nearly square. The two sides are nearly parallel; and the posterior extremity terminates in a rounded point, presenting neither hairs nor terminal appendages. Of the three pairs of natatory feet with which the body is furnished, the first are simple, and the two others biramose, as in the species just mentioned; all are armed with long flexible setæ destined to assist in natation. The articulations of these feet are very nodulose, and well fitted to facilitate movements. The *buccal apparatus* is proboscidiform and tolerably elongate; it is widened at its orifice, and appears to be furnished with two little jaws. It is erectile, and may lie along the thorax or rise up perpendicularly.

The embryo, seen upon a white ground, appears black, but, when illuminated, it is red. It swims slowly, and with much less activity than those of the species with which we have compared it.

Coloration.—This Crustacean varies much in colour. It is sometimes bright yellow slightly tinged with vermilion; sometimes it is of the latter colour but rather pale, brown, or leather-coloured (*chamois*). The head, the first thoracic segments, and the last segment of the abdomen are always white. The intestine, when full, is deep black; the ova are yellow or brown; the eye, as already stated, red changing to blue.

Habitat. Found, pretty commonly, hidden beneath the scales of the young of the green-streaked Wrasse (*Labrus Donovani**), where it lives as a parasite.

§ 2. *History.*

It is already a long time since, while seeking for parasites on fishes, we first noticed that the young Green Wrasses often presented on the fore part of the sides of the body, not far from the eye and the branchial aperture, a small tumour, the bright-red colour of which contrasted with the green tint of the fish. This peculiarity would not have attracted our attention so much if we had not seen it reproduced almost constantly under similar

* The Breton fishermen call this fish *Castrik*. It is extraordinary that the parasite is absolutely found only upon this species, although there are several in the same genus which have the greatest analogy to each other.

conditions—that is to say, exclusively upon young fishes*, always of the same species and at the same place, and generally on the right side, never hitherto on both sides. It occurred to us to open one of these tumours, in the expectation of finding some Entozoa in it, in a cyst or scirrous tube; but what was our surprise when we found that we had to do with a being which, although belonging to a higher class, must none the less take a place among the lowest ranks of the Crustacea with which it might be classed.

This tumour is of about the size of a lentil, sometimes smaller, rarely larger. Two, or even three, may often be seen upon the same fish; but in this case one is always stronger than the others, and this is usually the first one, that is to say, the nearest to the spot above indicated. On carefully examining the tumour, it is seen to be formed by a certain quantity of scales, which are deranged from their usual symmetrical arrangement, convergent towards a centre, and superposed upon each other in such a manner as to form a projecting and culminating point, at the central summit of which we see a small round hole, evidently opened to establish an issue.

By carefully removing the lateral scales which are at the base of the cone, and have undergone no alteration, we arrive at those which, on the contrary, have undergone a modification. These, which are much thicker than the others, are, so to speak, double-bottomed. If they are torn off, we see, on looking at them from below, that they present a comparatively spacious cavity existing between the upper wall, which is concave, and the lower one, which is flat—an arrangement greatly resembling that of the shells of the *Anomiæ*, if it were not that in these Mollusca the two valves can open and close by means of the hinge placed at the upper part of the shell, whilst in the case now before us these two surfaces are soldered together, and are consequently immoveable.

The scales which have undergone the modifications just mentioned present below (that is to say, on their flat surface) two vertical perforations, of which that placed near the lower margin is always the largest; we also generally detect some other small holes pierced in the upper surface. These scales are applied to the side of the fish by the flat side. When we tear them off, we see at the spot which exactly corresponds with the large perforation above mentioned, a hollow or *sinus* pierced in the flesh,

* We have already had occasion to indicate that it is especially to young fishes that parasites attach themselves, probably as being less able to free themselves. This law appears to be general for all organized creatures: it is probably also for the same reason that old and inferior individuals are also attacked.

and evidently the result of an erosion produced by the parasite in obtaining its nourishment.

All these arrangements having been minutely described, it only remains for us to seek to explain their purpose.

When the double-walled scales are extracted from the place they occupied, and examined on their flat side, the parasite which is enclosed in the cavity existing between the two surfaces may be seen through the aperture pierced in the upper part. Generally it only presents the anterior part of the body at this orifice, and it is difficult to extract it therefrom, seeing that it is retained by a purulent and agglutinative secretion, in the midst of which it is immersed, and which causes it to slip when we endeavour to seize it. This must be done with care, as the least rough contact may wound it and immediately provoke the emission of the substances contained in the intestine.

The ova, which are glued together and form small, square, flat masses, also float in the above liquid.

When taken out of its refuge, the movements of the creature are quick and repeated, but always the same; they are reduced to contractions in a vertical direction and to nutations of the head, which is agitated horizontally to the right and left, so as to give rise to a certain very limited reptation, which sufficiently indicates that it is destined only to furnish the animal with a means of changing its position, but not its place.

The largest of the apertures, which corresponds directly, as has been stated, with the erosion or sinus produced below, leaves no doubt as to its nature or the purpose which has produced it; it is evident that it is by this orifice that our parasite, finding itself in contact with the fish on which it lives, obtains from it its nourishment.

As to the inferior aperture, it seems to us to be destined, by establishing a current, to facilitate the evacuation of the excrementitious matters which might accumulate in this retreat, and to renew the water, which, in consequence of the secretions, might be altered and no longer fit for respiration.

The small apertures pierced in the upper wall are probably intended to correspond with the perforation produced at the apex of the cone formed by the accumulation of the scales, and, by admitting the external water, to facilitate also either the expulsion and dissemination of the embryos, or the access of the male, which, concluding from the analogy of what is known to us, must possess means of locomotion which have been denied to his female.

Lastly, as regards the retreat in which this parasite shelters itself, we shall content ourselves with the following suppositions:—

We suppose that the embryo, at its escape from the egg, being still of extreme minuteness, penetrates by the base of the scale, and introduces itself between the two laminæ which form its two faces; that it raises and separates them slowly in such a manner as to double them, and that by its successive efforts it not only succeeds in creating a space in which it finds a lodging, but acts in such a fashion as to exert upon the scale an abortive influence which, by distorting its structure, modifies its form*. In fact, if we examine the first invasions of this parasite, we find that at first they are confined to a mere long, vertical, ampulliform canal, which afterwards becomes dilated at its base until it presents a capacity of nearly the same dimensions in all directions. The scales which present these proportions are usually not more than two or three in number; it appears that they suffice for the shelter of all the parasites which have to seek a refuge in them; we perceive only, generally in the same line, some small tubular conduits, of the same kind as those of which we have just spoken, which appear to be so many covered ways leading to these principal retreats. Lastly, it appears that these parasites have also a tolerably powerful active force, since they are not only able to make themselves a way between the laminæ of scales, which must present to them a certain resistance, but even perforate them at several points with facility; and the holes which they make are as if pierced by a punch and rounded with a borer.

The vitality of this Crustacean is very great: we have kept it more than a fortnight without giving it any nourishment, and we have found that the strongest pressure did not prevent it from agitating the palpi of its mouth with extreme vivacity for a long time.

§ 3. *Systematization.*

From what we have just said as to the mode of life of this parasite, it will be understood at once that, being sheltered from all contact, and completely protected from external dangers by the safe asylum furnished by its host, it does not require for its protection a solid carapace (accordingly that which covers it is a mere parchment-like envelope); that, having neither to defend itself nor to attack, it has no necessity for either offensive or defensive arms; lastly, that being reduced to a state of almost

* This deformation caused by parasitism need not surprise us, when we consider those produced by *Cynips*, to the mode of life of which that of our parasite presents some singular resemblances. These ways of communication, these roads constructed by the parasite, recall the subepidermic furrows and galleries which are formed by *Sarcoptes scabiei* for a similar purpose.

complete immobility, its useless locomotive appendages have become almost null or rudimentary; but, as it must provide itself with nourishment, it has, on the contrary, been completely furnished with everything that could be necessary to it for this purpose. We remark, in fact, that round the buccal orifice, which, from its proboscidiform structure, may furnish it with the means of absorbing liquids, there exists an auxiliary series of mandibles, arranged circularly and fitted, in case of necessity, to triturate solid objects, and that this organ is not only accompanied by palpi, but also by prehensile feet destined to aid them. Thus, therefore, notwithstanding its apparent nakedness, it is not the less true that it has been very completely provided for its needs.

And thus we have arrived at the most arduous portion of our work, which consists in finding the place in classification which must be assigned to our parasite.

It may be seen, indeed, from the description that we have given of it, that the characters upon which we depend are not very strongly marked; we may add that they were still more difficult to ascertain, in consequence, as already stated, of the opacity of the body of this Crustacean, which is comparatively very thick, and of its cylindrical form, which renders it very unstable on the slide, where it does nothing but roll about; hence, notwithstanding the long practice we have had with the microscope and the compressorium, we are not quite sure of having triumphed over these obstacles. Nevertheless, having operated upon a great number of individuals, and repeatedly verified our observations, we hope that in case we should have committed some errors, these will not be of much importance.

At the first glance, seeing the simplicity of structure of the parasite, we asked ourselves whether we really had to do with a Crustacean. Subsequently, after having attentively examined it, we perceived that it could only belong to this category, and, this being the case, that, from the primitive state of its organs, it must be referred to the lowest rank in the classification of these Articulata, and placed among the *Lernæocerea*. This opinion once admitted, we had to seek for the characters which might justify this view; and the following are those which seem to us to do so.

When we compared it, for example, with *Lernæa branchialis*, we were struck at once by the resemblance which exists between their buccal systems: this part in each is proboscidiform, and composed of a retractile siphon forming a sucker, which shelters itself between the projecting rounded margins protecting the two sides of the aperture of the mouth. We find also that, as in *Lernæa*, this orifice is surrounded by auxiliary feet, and, lastly

(and this is a special character of the *Lernæida*), that there exists *all round the body* a transparent border, which accompanies its outline through all its circumvolutions.

Moreover a circumstance which has no less attracted our attention, and which, in our opinion, is most curious, is the resemblance existing in the mode of life of the two parasites.

We know, in fact, that *Lernæa branchialis*, by means of its buccal apparatus, which, as in our parasite, does not appear to furnish any resources for this purpose, and which appears rather destined to draw up liquid materials by suction, succeeds nevertheless, in course of time, in perforating the very thick and resistant first wall of the branchial arch of fishes, in order to lodge its radiciform frontal system in the space occurring between the two plates of this bony part. Our parasite, by similar actions, also, by separating and raising the two laminæ which form the scales of the fish on which it has established itself, succeeds in altering their structure, thus creating for itself a refuge in which it is entirely lodged, and where it lives in peace and sheltered from all dangers.

From what has gone before, and notwithstanding the differences existing between the two species which we compare, we do not hesitate to think that they must belong to the same order; and we form for our parasite a new family, which we characterize as follows:—

Family **Lernæosiphonostomea.**

The females fixed upon their victim by means of the scales of the latter, in which they hollow out a residence. Several footjaws placed around the mouth. Head not horned. Oviferous pouch large and flat.

Genus Leposphilus*, nobis.

Body fusiform, divided into ten [eleven] segments, which are very distinct, with the exception of the third and fourth; of these, four [five] are thoracic and six abdominal; all surrounded by a transparent border. *Head* small, rounded at the apex, bearing above a median *eye*, and beneath presenting the buccal orifice, which emits, in a proboscidiform process, some denticulated jaws adapted for the trituration of objects, and laterally three pairs of prehensile footjaws. *Antennæ* very small, rounded at the end, and terminated by divergent hairs. *Abdominal segments* retractile, and capable of invagination; last segments terminated by divergent appendages. Embryo ovulate, furnished with three

* **This name ought evidently to be *Lepidophilus*, and the specific name *Labri*, instead of *Labrei*.**

pairs of feet. Eggs agglutinated, and forming a broad flat mass.

Sp. *Leposphilus Labrei.*

Colour varying from yellow to pale red. Length about 10 to 12 millims. Male unknown.

Inhabits the Green Wrasse, in the scales of which it hollows out a retreat.

XV.—*Observations on the Development and Position of the Hymenoptera, with Notes on the Morphology of Insects.* By A. S. Packard, Junr., M.D.*

The following notes form an abstract of a more extended memoir upon the changes of the insect after leaving the egg, not touching upon the evolution of the embryo.

After the larva has become full-fed, as it is about to enter upon the semipupa state, its body undergoes the following changes:—The thoracic rings and head become more elongated and fuller, so that whereas in the larva the underside of the anterior and posterior halves of the body are closely appressed to each other, now the two halves begin to recede, and the grub, as it lies in its cell, is but half doubled upon itself. With this important change of posture, the whole body becomes more cylindrical and rounded. Thus the sides (arthropleuræ) of the thoracic ring become absorbed, and do not project out from the walls of the body as in the larva; and later still, the corresponding area in the abdomen likewise almost wholly disappears.

The greatest activity, however, is observable about the cephalic portion of the body; for here the greatest differentiation of parts is to occur. The head of the pupa, already partially formed beneath the prothoracic ring, though as yet very small, by its presence still affects very sensibly the form of this region in the larva, the skin of which still remains unbroken, though very considerably distended. The whole length of the head (fig. 1 *a*) and prothorax (fig. 1 *b*) together is now equal to the united length of the head and thorax in the larva originally. To effect this, the larval head is greatly extended forwards, and the prothorax is three times as long as before, and much narrower, the sides converging towards the base of the head. The two posterior thoracic rings are also twice as long as in the larva. On the under (sternal) side the mouth-parts are also elongated; and

* Communicated by the author, from the 'Proceedings of the Boston Natural History Society,' Feb. 7, 1866.

the labium projects a little beyond the head, owing to the increased size of the mouth-parts over those of the larva.

At this period, the two pairs of wings are very equal in size, the posterior pair but little smaller than the anterior pair, and inserted much higher up the ring nearer the median tergal line of the body; and in the succeeding stage the posterior pair are seen to be scarcely smaller than the anterior pair, and exactly parallel in their insertions, their longitudinal diameter, and their tips. This change in the position of the posterior pair of wings, so important in a morphological point of view, is accompanied by a corresponding change in the proportions of the thorax. The metathorax has become mostly absorbed, so as to resemble more the same part in the pupa; while the mesothorax retains much of its original proportions, though becoming more compact and presenting less of the tergal area.

During this time the head has also greatly increased, especially in the size of the appendages; the eyes, antennæ, and mouth-parts begin to assume the size and shape of those of the pupa. Development here, as in the thorax, begins in the most important central parts, and proceeds outwards to the periphery.

In this stage (fig. 1), when the mouth-parts of the semipupa have become solid enough to enable the larval head to be stripped off without lacerating the extremities of the appendages, the head is seen to be divided into two portions. The basal region or body of the head, which is lodged under the prothorax of the larva, is orbicular when seen from the front; and its sides are continuous with the sides of the thorax, as is also the vertex, which is likewise of a continuous slope with that of the anterior tergal portion of the thorax. Seen from the side, there is no separation as yet between the head and thorax. The outline of the eyes is distinct, but they are not raised above the surface of the head. The antennæ, clypeus, and mouth-parts collectively form a second anterior portion separated by a curved line from the epicranium. It is this anterior portion which lies in the larval head in this stage. The great increase of size of the appendages of the semipupa have forced forward the hard crust of the larval head, which suggested to Ratzeburg the idea that the head of the pupa was originally composed of the first two rings (*i. e.* head and prothorax) of the body of the larva*. The antennæ are flattened down upon the surface, resting on each side of the small trapezoidal clypeus, over the front edge of which they again meet, when they are flexed upon themselves,

* "Ueber Entwicklung der fusslosen Hymenopteren-Larven, &c." (Nova Acta Natur. Curios. tom. xvi. 1832). Westwood has fully shown the fallacy of this idea (Trans. Ent. Soc. London, vol. ii. p. 121); and our own observations corroborate his statements and conclusions.

lying on each side of the labrum with its palpi and the maxillæ. These appendages do not as yet project much beyond the antennæ, being short and papilliform, preserving the general form of the same organs in the larvæ.

At this period the elements (*sterno-rhabdites,* Lacaze-Duthiers) composing the ovipositor lie in separate pairs, in two groups, exposed distinctly to view. The ovipositor thus consists of three pairs of slender non-articulated tubercles arising on each side of the mesial line of the body, in juxtaposition. The first two pairs arise from the eighth abdominal ring, and the third pair grow out from the anterior edge of the ninth ring. The ends of the first pair scarcely reach beyond the base of the third pair. With the growth of the semipupa the terminal or tenth ring decreases in size, the tip of the abdomen is gradually incurved towards the base (fig. 2), and the three pairs of rhabdites approach each other so closely that the two outer ones completely ensheath the inner, until a complete distensible tube is formed, which gradually is withdrawn entirely within the body (see fig. 4). The male genital organ is originally composed of three pairs of non-articulated tubercles, all arising from the *ninth* abdominal ring, being sternal outgrowths, and placed on each side of the mesial line of the body, two being anterior and very unequal in size, and the third pair nearer the base of the abdomen. Thus, in their position, the three pairs of tubercles destined to form the male intromittent organ cannot be said to be strictly homological with the female ovipositor; nor can the external genital organs be considered in any way homologous with the limbs, which are articulated outgrowths budding out between the sternal and pleural pieces of the *arthromere**. This view will apply to the genital armature of all insects, so far as I have been able to observe. It is so in the larva of *Agrion,* which completely repeats the structure of the ovipositor of *Bombus* in its essential features detailed above. Thus in *Agrion* the ovipositor consists of a pair of closely appressed ensiform processes which come out from under the posterior edge of the eighth abdominal ring, and are embraced between two pairs of thin lamelliform pieces of similar form and structure, arising from the sternite of the ninth ring. These sternal outgrowths do not homologize with the long, filiform, antenna-like, jointed appendages of the tenth ring, as seen in the Perlidæ and most Neuroptera and Orthoptera, which,

* This term is proposed as better defining the ideal ring or primary zoological element of an articulate animal than the terms *somite* or *zoönite,* which seem too vague; so also the term *arthroderm* for the outer crust or body-walls of Articulates, and *arthropleura* for the pleural or limb-bearing region of the body, being that portion of the arthromere comprised between the tergite and sternite.

arising as they do from the arthropleural or limb-bearing region of the body, *i. e.* between the sternum and episternum (or lower pleurite), are strictly homologous with the abdominal legs of the Myriapoda and the "false legs" of caterpillars; so that in these genito-sensory appendages we perceive faint traces of the idea of antero-posterior symmetry first observed in Vertebrates by Oken, and more recently by Professor Wyman and Dr. B. G. Wilder, involving a repetition of homologous appendages at the two opposite poles of the body. The broad leaf-like appendage to the tenth ring in *Agrion* seems homologous, both in function and structure, with the respiratory lamellæ of the swimming abdominal limbs of the lower decapodous Crustacea and the Tetradecapods, which perform the function of gills.

During this stage, the basal ring of the abdomen of *Bombus* (fig. 2 *c*) is plainly seen to be transferred from the abdomen to the thorax, with which it is intimately united in the Hymenoptera. This we deem the most essential zoological character separating the Hymenoptera from all other insects. This transfer of an entire arthromere from one region to that next in front, involving the remodelling of the entire form of the insect, though not uncommon in the Crustacea, is, in the class of Insects, peculiar to the higher families of the Hymenoptera, as in the lowest (the Tenthredinidæ) the transition is but partial, corresponding to the Lepidoptera in this respect. It is an instance of the principle of cephalization advanced by Professor Dana, so fully illustrated in the Crustacea, where in some groups changes occur in the primitive number of arthromeres, proved by the inconstant number of rings (arthromeres) forming the abdomen and cephalothorax respectively. This transfer of the zoological elements from the posterior end of an animal towards the head, involving in this act the entire reconstruction of the animal form, lies at the basis of all sound classification, and is a principle which must be followed by every student dealing with the classification of the larger divisions of the animal kingdom.

So intimately united with the thorax is this elemental ring, that, from its sculpturing, its coloration, and, in fine, its close mimicry of the normal thoracic segments, our best observers have united in calling it the metathorax, and homologizing it with that ring in the lower insects. Latreille and Audouin considered it as the basal ring of the abdomen, as did Newman, who termed it the *propodeum*. But our best hymenopterists of thirty years' standing consider it to be the metathorax, with the exception of Baron Osten Sacken, in his articles on the Cynipidæ*. During the autumn of 1863, when the observa-

* Proceedings of the Entomological Society of Philadelphia, vols. ii., iii.

tions here recorded were made, our attention was drawn* to this part. At this period the thorax is one-third smaller than in the pupa. The position of the three thoracic spiracles can be easily discerned. On the two posterior rings of the thorax they are seen situated in their respective "peritremes" (Audouin), which pieces lie at the base and just under the insertion of the wings, on the posterior half of the ring, while on the prothorax the peritreme lies contiguous to and partially under the posterior edge of the vascular tubercle, which in position is exactly homologous to that of the wings.

It is thus demonstrated that the wings grow forth, first as vascular sacs, through the arthroderm, just above the line of spiracles, and at the line of juncture of the lower edge of the tergite and upper edge of the upper pleurite or epimerum; while, on the other hand, the limbs grow out through the line of juncture of the sternite and the lower pleurite or episternum.

In what may be termed the third stage (fig. 3), though the distinction is a very arbitrary one, the change is accompanied by a moulting of the skin, and a great advance has been made towards the pupa form (fig. 4). There are seen to be two distinct regions to the body—the anterior, consisting of the head and thorax, which are placed close together, and the abdomen, which is separated from the rest of the body by a deep constriction. We cannot fail to be at least reminded of the biregional Crustacean—an analogy which Oken has called attention to, and which has been successfully used by that author in comparing the pupæ of Insects with Crustacea.

At this period the mode of sloughing of the larval skin is well shown. Instead of the violent rupture of the skin at one point on the tergum of the thorax, as in the majority of insects, accompanied with the great exhaustion consequent on the act, which makes the operation a perilous one to most Insects and Crustacea, in this species (and most probably all the Hymenoptera which at this stage have a soft tegument) the skin breaks away gradually, in shreds, from the tension due to the unequal growth of the different parts of the body. Thus, after the skin beneath has fully formed, shreds of the former skin remain about the mouth-parts, the spiracles, and anus. Upon pulling these, the lining of the alimentary tube and tracheæ can be drawn out, sometimes, in the former case, to the length of several lines. As all these internal systems of vessels are destined to change their form in the pupa, it may be laid down as a rule, in the moulting of Insects and Crustacea, that the lining

* Proceedings Essex Institute, vol. iv., "The Humble Bees of New England and their Parasites," &c., April 23, 1864, p. 3, note.

of the internal organs, which is simply a continuation of the outer tegument, or arthroderm, is, in the process of moulting, sloughed off with that outer tegument*.

Whereas before the head and thorax together were but little more than one-half as large as the abdomen, now they are conjointly nearly equal in size to the abdomen (fig. 3). The greatest changes have gone on in the two anterior regions of the body. They unitedly tend to assume a spherical form, while the elongated abdomen is shortened and very perceptibly altered in form, approaching near that of the pupa, and the whole body is flexed more upon itself.

The head is still closely appressed to the prothorax, but much less so than formerly, since the increasing size and different proportions of the prothorax have pushed it away. This act of separation has effected an important change in the position of the head as related to that of the rest of the body. It is now truly vertical. Before, its greater length was more continuous with the longitudinal axis of the body, that is, nearly horizontal, or rather inclined at a slight angle from the longer axis. The horizontal position is normal in the lowest insects, as the Neuroptera. In the Hymenoptera the longer axis of the head is most completely vertical.

The head in its size, and the development of the appendages, including the mouth-parts, now begins to resemble those parts in the pupa. The eyes are larger and more distinct than before; the maxillæ and antennæ, though still very short, are shaped more like those parts in the pupa. In the antennæ, the most marked change takes place in the three basal joints, or the "scape," of which the second joint now becomes the longest and somewhat contracted in the middle and round at the extremity; while the terminal joints are still doubled upon themselves, and rest folded upon the mouth-parts.

The thorax also resembles that of the pupa, though longer; and the basal ring of the abdomen (propodeum) is still exposed to view when seen from above. At this stage the præscutum of the mesothorax, before very distinct, is no longer seen, as in the pupa it is mostly absorbed and passes out of sight, though in the Tenthredinidæ it is a large and conspicuous portion of the mesonotum.

Most interesting changes have occurred in the hinder part of the thorax. Whereas in the previous stage the mesoscutellum was immersed in the ring to which it belongs, it is now elevated and becomes very prominent; the thorax posteriorly falls rapidly

* It remains yet to be proved whether the biliary tubes, salivary glands, and inner genital glands and cavities form exceptions to this rule.

away from it, at an angle of about 60°, and its hinder edge is much thickened and folded down on itself. The metathorax is entirely visible from above. The scutum is now entirely separated into the two lateral halves, being transversely narrow triangular pieces, the bases of which are square and closely adjoin the insertion of the hind wings, while their apices are much produced and extend under the mesoscutellum. The metascutellum is now distinctly seen to be a linear transverse piece reaching on each side to the middle of each half of the scutum. The basal ring of the abdomen (propodeum, fig. 3 *c*) is now undergoing the process of being transferred from the abdomen to the thorax. Whereas before it was a segment much narrower than those contiguous, it has now become still smaller, and its tergal portion, instead of being nearly horizontal, is now much inclined downwards posteriorly.

The abdomen, though still larger, approaches much nearer the form of the pupal abdomen than before, and the segments are flatter. The second ring has become much contracted, as it is destined to become the "pedicel" or "first abdominal segment" of descriptive entomology. There is now a differentiation of the elements of the ring. Thus the tergites (notum, fig. 3 *f*) are clearly distinguished from the pleurites (fig. 3 *e*, flanks) and *urites* (Lacaze-Duthiers, fig. 3 *d*, ventral side). The spiracles are situated on the upper edge of the pleurites, opening out just under the edge of the tergite. As we go back towards the tip of the abdomen, the tergites as well as the urites decrease in width, while the pleural region or pleurites increase in size. It is the pleural portion, however, which is afterwards to become absorbed, by which the dorsal and ventral portions of the abdomen approximate more intimately and overlap each other, thus making the tip acute, as in the pupa (fig. 4) and especially the perfect bee.

During this time the ovipositor, owing to the diminished size, by absorption, of the parts supporting it, has become gradually more and more retracted, while the entire tip of the abdomen is more acute and incurved.

The Pupa State.

In this stage (fig. 4) the whole body is shorter, and there is a decided transfer of the bulk of the body towards the head. The head has increased in size, the thorax is one-third larger, while the greatly shortened abdomen is a third shorter than in the preceding stage. At this period the longitudinal axis of the body is less curved than before. The mesoscutellum is now placed just in the middle of the body, when before it was situated at the anterior third. This change also carries the wings

far back, to the middle of the body, from their previous situation very near the head and on the anterior third of the body. The limbs are greatly enlarged; the tarsi of the hind pair now reach near the tip of the abdomen, whereas before they were simply folded upon the thorax, not reaching to or resting upon the abdomen.

Great changes have occurred in the appendages of the head. The clypeus, labrum, and mandibles are now exposed to view. The antennæ have become straightened and greatly elongated, and a corresponding change has occurred in the maxillæ and labium with its palpi, which now reach to the middle of the abdomen, while the lingua extends as far as the seventh abdominal segment. This stage, therefore, is characterized by important modifications in the size and position of the extremities and appendages of the head, thorax, and abdomen. In the thorax the changes are not especially remarkable. The scutellum is now in contact with the base of the abdomen, as if the whole thorax had been carried backward, and the entire abdomen brought forwards and upwards, due to the absorption of the metathoracic ring and basal ring of the abdomen.

Thus each of the three regions of the body is a centre of development, the gradual perfection of the appendages belonging to each region proceeding from the centre towards the periphery, beginning at the insertion of the limbs to the trunk, and gradually perfecting their development towards the extremity. Hence the wings, the tarsi, or terminal joints of the limbs, and the abdominal appendages are the last to be developed and perfected. The anterior part of the thorax is perfected earlier than the posterior, while in the abdomen the development goes on from behind forwards. Prof. Dana has shown that in the Crustacea the cephalothorax and abdomen are each a distinct centre of development, in which progress reaches to a wider or narrower circumference in different species*. Researches on the embryology of the higher Annelids show that the development of worms proceeds from a single centre†.

At this stage, which may be properly called the pupa state, the eyes begin to turn dark, and a few hairs develope themselves upon the upperside of the abdomen; but the stage is so transitory, that in a long series of individuals it is impossible to select a single individual and denominate it a *pupa*, since there is no

* Introduction to the Crustacea of the U. S. Exploring Expedition, vol. i. p. 22.

† See S. Lovén, K. Vetenskaps-Acad. Handl. 1840 (Wiegmann's Archiv, 1842, part 1). M. Sars, Development of *Polynoë cirrata* (Wiegmann's Archiv, 1845, part 1). Milne-Edwards (Ann. Sc. Nat. 1845).

pause in the metamorphosis for a special biological design, such as obtains in the Lepidoptera and the majority of lower Insects. The terms larva, pupa, and imago are therefore not absolute terms.

Subimago State.

Certain individuals which would upon a casual glance be mistaken for "pupæ" differed so much from what we have called pupæ above, that they may be said to be analogous to the *subimago* state of Ephemeridæ. In this state the arthroderm, owing to the rapid deposition of chitine, is denser and harder; the wings are as large as in the perfect bee, and the joints of the legs are spiny, while the ovipositor has become wholly withdrawn within the walls of the abdomen.

In some specimens, remains of a thin pellicle were found upon the extremities; so that we are neither justified in calling this individual an *imago* nor, on the other hand, a *pupa*. The individuals had not left their cells. Their feet had not yet been used for purposes of locomotion, nor their jaws to assist in making their way out of their cells, while the hairs are nearly concolorous all over the body, though very faintly shaded with yellowish on the dorsal and lateral portion; so that the *species* can be distinguished, as some of the specific characters depending on ornamentation are at this time apparent. We have observed facts indicating three moultings of the skin during the so-called pupa state, in distinction from the *larval* and *imago* states; and it is highly probable that there are more. During the larval condition it would be safe to say that there are *four* distinct moultings, as there are five distinct sizes of larvæ. In some of the eggs the larval forms can be indistinctly seen through the thin walls, which we would homologize with the skin of the insect after birth; for the *fertilized* egg must be regarded as the insect in its inception, in a state equivalent to the larval, pupal, or perfect state of the insect. The genus *Bombus*, therefore, may be considered to undergo a series of at least ten moultings of the skin; and we are inclined to think further observations will tend to increase the number. Lubbock * has described twenty in *Ephemera*; and five have been noticed in several genera, such as *Meloë* and others.

The sexes of the larvæ can be easily distinguished, as the genital armature appears through the transparent skin.

The specific differences between the larvæ of the different species of *Bombus* are of the slightest possible amount, as they only differ in size, the rings of the body being smooth or rough,

* Trans. Linn. Soc. vol. xxiv. part 2 (1863).

and in having more or less clearly defined sutures between the pieces composing the head. The eggs of the different species compared presented no appreciable differences.

In the pupa state, the two sizes of male, female, and workers can be more readily appreciated than in the imago state, as the insects can be more easily measured and comparisons made. Corresponding cases of dimorphism in other insects will probably be studied to great advantage when the insects are observed at this period of life. Between the two sizes of the ♀ in the pupa of *Bombus fervidus* there was a difference of ·05 inch, and in the ♂ ·03 inch. In a number of the worker pupæ of *Bombus separatus* there was a difference of ·04 inch between the two broods of workers, the more advanced brood being smaller, and not only shorter but also narrower.

In this connexion we would present some views relative to a theory of the number of arthromeres composing the head of Insects (*Hexapoda*), and the number and sequence of their appendages, suggested by studies of the larval forms of Hymenoptera, and especially the lower Neuroptera, not omitting insects belonging to other suborders, and some forms of Crustacea. After Savigny had shown that the mouth-parts of Insects and Crustacea were jointed appendages like those attached to the thorax, and therefore repetitions of an ideal jointed limb or appendage, Audouin proved that in the ideal arthromere, of which the bodies of all Articulata are each a congeries arranged in a longitudinal series, the periphery should be distinguished into an upper (*tergite*, Duthiers), lower (*sternite*, Duthiers), and pleural part, and that in the thorax the legs were thrust out between the pleurite and sternite, and the wings grew out between the pleurite and tergite. The arthropleural region is therefore the limb-bearing region of the body, and the different parts of the ideal ring are developed in a degree subordinate to the uses of the limbs and wings. Thus in the walkers, such as the Carabidæ, the pleural and tergal regions are most developed; while in those insects, such as the Dragonflies, which are constantly on the wing, and rarely walk, the pleural region is enormously developed, and the tergites and sternites attain to their minimum development. The muscles used in flight are greatly increased in size over the atrophied muscles brought into requisition by the act of walking. In the Hymenoptera, however, which are both walkers and fliers, the three portions of the ring are most equally developed.

These parts of the arthromere are simplest in the abdomen, and become more differentiated in the thorax, where the numerous pieces composing them have been classified and named, mostly by Audouin, M'Leay, and Lacaze-Duthiers. Scarcely

an attempt has been made to trace these parts in the rings of the head by those who have proposed theories of the number of arthromeres in the head of insects.

As we can understand the structure of the thorax better after studying the abdomen, so we can only homologize the different head-pieces after a careful study of the thorax of Insects and the cephalothorax of Crustacea, which thus afford us a standard of comparison.

Since the arthropleural is the limb-bearing region in the thorax, it must follow that this region is largely developed in the head, to the bulk of which the sensory and appended digestive organs bear so large a proportion; and as all the parts of the head are subordinated in their development to that of the appendages of which they form the support, it must follow logically that the larger portion of the body of the head is pleural, and that the tergal and, especially, the sternal parts are either very slightly developed or wholly obsolescent. Such we find to be the fact. As to the number of rings composing the head, it is evident that it is correlated with the number of appendages they are to support. Hence, as in the thorax there are three rings bearing three pairs of appendages or legs, it follows that in the head, where there are seven pairs of appendages, there must be seven rings. That there are seven such appendages, among which we would include the eyes, which, if not homologous with the limbs, or, more properly speaking, repetitions of the ideal appendage, are at least their equivalents, in that they are situated on a distinct ring, as are the ocelli, which are exact equivalents or repetitions of the eye, is evident.

The larvæ of *Ephemera* and *Libellula*, in the head of which these parts of the cephalic rings, by reason of the degradational character of the insects, appear in their simplest forms, afford us the best material for study. In the head of the larva of *Libellula* we have observed that the greatly elongated labium, masking, when at rest, the mandibles, is in reality composed of three *sternites*, immersed in and surrounded by three *pleurites*, all bearing appendages, the basal pair being the mandibles, the middle pair maxillæ, and thirdly, the pair of labial palpi, all of which are placed behind the mouth-opening. Beyond and in front of the mouth are successively placed the sensory organs, the antennæ, the pair of eyes, and what we must consider two pairs of ocelli, since the early forms of *Ephemera* and the early stages of *Bombus* show the three ocelli resting on three separate pieces, the two posterior pieces (*pleurites*) forming a pair, while the single ocellus in advance is placed on a triangular piece which we regard as two pleurites united on the median line of the body, as the ocellus has a double form, being

broad, transversely ovate, and not round, as if resulting from the fusion of two originally distinct ocelli.

The antennæ*, by their form and position, naturally succeed the labial palpi. Considering how invariably in the Crustacea the eyes are situated in front of the gnathopods, we feel convinced that the same position must be allowed them in the head of insects. This will bring the ocelli most in advance of all the other appendages. The bulk of the head of insects must, then, be formed by the great expansion of the eye-pleurites, which, so to speak, are drawn back like a hood over the basal rings, while the rings bearing the maxillæ and labial palpi and the antennary ring are thrust out, telescope-like, through the large swollen eye-ring; as in Decapods, a single ring covers in the aborted ring composing the rest of the cephalothorax, as Edwards and Dana have shown, and our investigations have taught us. Thus the upper surface of the head is composed of expansions of the pleural pieces of the ideal arthromere, which never developes the sternal nor probably the tergal portions in front of the mouth. Thus each region of the insectean body is characterized by the relative development of the three elements of the arthromere. In the abdomen the upper (tergite) and under (sternite) surfaces are most equally developed, while the pleural line is reduced to a minimum. In the thorax the pleural region is much more developed, either quite as much as or often more than the upper or tergal portion, while the sternite is reduced to a minimum. In the head the pleurites form the main bulk of the region, the sternites are reduced to a minimum, and the tergites are almost entirely aborted, or may perhaps be identified in the centre of the "occiput," or what is probably the mandibular (or mandible-bearing) ring, and in the "clypeus."

In the abdomen the same abolescence of parts strikingly exemplifies what may be called the law of systolic growth, where certain parts of the zoological elements of a body are in the course of development either greatly enlarged over adjoining parts or become wholly obsolete, as stated by Audouin and St.Hilaire, who ascribed it to the principle of "arrest of development," which is now used by physiologists in a more limited sense. While, as we have shown above, the genital armature of insects is not homologous with the limbs, there are, however,

* Repeated observations have taught us that the idea advanced by Zaddach (Untersuchungen über die Entwickelung und den Bau der Gliederthiere) and adopted by Claparède (Recherches sur l'Évolution des Araignées), that the antennæ of the larvæ are not homologous with those of the perfect insects, is untenable. In the larvæ of all Hymenoptera and numerous families of Lepidoptera and Neuroptera they are identical in position in all stages of development.

true jointed appendages attached to the ninth or tenth abdominal rings or both, which are often antenniform, and serve as sensorio-genital organs in most Neuroptera and Orthoptera. The abdominal rings are confined, as a rule, to the two lower suborders of Insects, and are homologous with the "false legs" of the larvæ of Lepidoptera, the abdominal legs of Myriapoda, and, we believe, with the three pairs of abdominal appendages or spinnerets of the Arachnids. As in the most anterior rings of the head, so in the terminal abdominal rings, there only remain minute portions of the arthromere, which are tergal pieces, the other two elements of the ring being rarely present, or entirely aborted. The two opposite poles of the body are therefore fashioned according to the same laws, and are morphologically simply repetitions of each other.

In conclusion, we consider that twenty rings (arthromeres), as a rule, compose the bodies of insects, of which seven are contained in the head, three in the thorax, and ten in the abdomen, and that, as thus grouped, forming three distinct regions, the Insects differ from all other Articulates, standing as a class above the Crustacea and Worms. The Arachnids and Myriapods, as Mr. Scudder* has shown, agree with the Insects in possessing a distinct head separated from the thorax or "pseudocephalothorax;" so that the Myriapoda do not form a class by themselves equivalent to the Crustacea, or Worms, or Insects, but, with Leuckart, Agassiz, and Dana, we would prefer to rank them as an order of the class Insects†.

In a former communication‡ we proposed a classification of Insects into two series of suborders (not, however, agreeing with the Haustellata and Mandibulata of Clairville), of which the lower begins with the Neuroptera, and, through the Orthoptera and Hemiptera, culminate in the Coleoptera; while the second series ranks higher as a whole, beginning with the Diptera and ending with the Hymenoptera, which thus stand at the head of the Articulata. The Hymenoptera differ from all other insects in having the basal ring of the abdomen thrown forward upon

* Proc. Bost. Nat. Hist. Soc. vol. ix. p. 69, May 1862.

† The embryology of Arachnids, as worked out by Claparède, shows that the larva is strikingly worm-like, distinct rings ("protozoonites") appearing before the biregional Arachnid form is assumed. The embryos of two genera of mites, *Demodex* and *Acarus*, are at first hexapodous, as Newport has shown that of *Julus*, a Myriapod, to be. The close homologies of the Arachnids and Myriapods with the Insects (Hexapoda) convince us that the three groups, whether we call them orders or classes, are as a whole equivalent to the Crustacea or Worms.

‡ "Synthetic Types of Insects" (Bost. Journ. Nat. Hist. vii. 1863); "How to observe and collect Insects" (Second Annual Report of Maine State Survey, 1863).

the thorax; in having the three regions of the body more distinctly marked and more equally developed than in other insects. The mouth-parts are more equally developed, and at the same time more differentiated in structure and function; there are no abdominal jointed appendages present in the adult form, while the external generative organs are more symmetrically developed and more completely enclosed within the abdomen in the highest families than in any other suborder of Insects. They afford the highest types of Articulates, being more compact, less loosely put together, and thus presenting less of degradational features than any of the other suborders; but the most valuable *single* character is the transfer of the first abdominal ring forwards to the adjoining region, which involves an entire remodelling of the body, throwing *forwards* the prime elements of the organism, by which it becomes more cephalized, and thus the nervous power is rendered more centralized than in all other Articulates.

Selecting the Honey-bee as the type, being, in our view, the most perfectly organized of all insects, we find the head larger and the abdomen smaller in proportion than in other insects, accompanied with the most equable and compact development of the parts composing these regions. The brain-ganglia are largest and most developed, according to the studies of entomotomists. The larvæ, in their general form, are more unlike the adult insects than in any other suborder of Insects, while the pupæ most closely approximate to the imago. They are short, cylindrical, footless, worm-like grubs, which are helpless, and have to be fed by the prevision of the parents. In undergoing a more complete metamorphosis than any other insects, in the unusual differentiation of the sex into males and females and sterile females or workers, with a further dimorphism of these three sexual forms and a consequent subdivision of labour among them—in dwelling in large colonies, thus involving new and intricate relations between the individuals of the species and other insects—their wonderful instincts, their living on the sweets and pollen of flowers, and not being carnivorous in their habits as are the Neuroptera and a large proportion of the Orthoptera, Hemiptera, Coleoptera, and Diptera, and their relation to man as a domestic animal subservient to his wants,—the bees, and Hymenoptera in general, possess a combination of characters which are not found existing in any other suborder of Insects, and which we must believe rank them first and highest in the insect series.

Likewise the Hymenoptera are more purely terrestrial insects than all others. The Neuroptera are, as a whole, water-insects: their larvæ live in the water, and the perfect insects live near streams and pools. The Orthoptera are more terrestrial. Among

the Hemiptera are numerous aquatic species, as there are in all the other suborders except the Hymenoptera, of which only two genera are found swimming, in the adult state, on the surface of pools; and they are the low minute Proctotrupids, *Prestwichia natans* and *Polynema natans*, Lubbock. As we have previously shown, the Hymenoptera do not imitate or mimic the forms of other insects, but, on the contrary, their forms are extensively copied, in the Lepidoptera and Diptera especially. There are synthetic types or mimetic forms which bind these suborders into a single series. As the Coleoptera, Hemiptera, Orthoptera, and Neuroptera are bound together by homomorphous or mimetic forms into a series by themselves, so the Hymenoptera, Lepidoptera, and Diptera possess their synthetic types linking them together.

Another and very accurate method of determining the relative rank of the larger groups in nature is by comparing the degradational forms occurring in each group. Among the Neuroptera the lowest wingless forms, such as *Lepisma* and allies, most strikingly resemble the Myriapods in the great equality in size of the arthromeres composing the body, and the slight distinctions preserved between the three regions into which the body is divided. The largest, most vegetative, monstrous, and bizarre forms of insects are found among the Neuroptera and Orthoptera. Among Hemiptera the parasitic wingless lice, and among Coleoptera the low *Meloë* and Stylopidæ, afford instances of a genuine complete parasitism such as obtains more fully among the low Crustacea and worms. While we find the degraded types of Insects belonging to the lower series of suborders present elongated, worm-like, myriapodous forms, in ascending to the second and higher series of suborders, the lowest wingless dipterous *Pulex* assumes a much compacter, more cephalized form; while in the wingless *Chionea*, which wonderfully mimics the higher Arachnids, there is a still greater concentration of the arthromeres. This concentration of the body progresses towards a higher type in the degradational forms of the Lepidoptera, such as the wingless females of *Orgyia*, *Anisopteryx*, and *Hybernia*. In ascending to the wingless Hymenoptera, such as *Pezomachus*, *Formica*, and *Mutilla*, there is a closer approximation to the winged normal form of the suborder. While in the lower Insects the loss of wings involves apparently a total change in the form of the body, in the Hymenoptera this change is remarkably less than in any other insects, and the tripartite form of the insectean body is more strongly adhered to.

Again, in the degradational winged forms of the Hymenoptera we find the antennæ rarely pectinated—a common occurrence in the lower suborders; also the wings of the minute Proctotru-

pidæ are rarely fissured, and when this occurs they somewhat resemble those of *Pterophorus*, the lowest Lepidoptera ; and in but a single hymenopterous genus, *Anthophorabia*, are the eyes in the male sex replaced by simple ocelli, like those in *Lepisma* and other degradational forms of the lower Insects.

What we know of the geological range of Insects proves that the Hymenoptera were among the last to appear upon the earth's surface. The researches of Messrs. Hartt and Scudder prove that the earliest known forms of insects found in the Devonian rocks of New Brunswick were gigantic, embryonic, and, in fine, degradational types of Neuropterous and Orthopterous insects. The Coleoptera appear in the Mesozoic rocks, where the lower Hymenoptera first appear in limited numbers, including representatives of the Formicidæ and lower families, and with them the Lepidoptera and Diptera.

We have throughout this article spoken of the Neuroptera as a group equivalent to the Orthoptera or Hemiptera or any other of the suborders of Insects. We believe thoroughly in the Neuroptera as limited by the early entomologists. The Odonata are the types of the suborder, and the Termitidæ, Psocidæ, Phryganeidæ, Perlidæ, Hemerobiidæ, Sialidæ, Panorpidæ, Libellulidæ (Odonata), Ephemeridæ, and Thysanura are closely interdependent groups, and circumscribed by the most trenchant characters, which they possess in common, and which separate them from the closely allied Orthoptera, into which, by modern German authors especially, some of their families appear to us to have been unwarrantably merged.

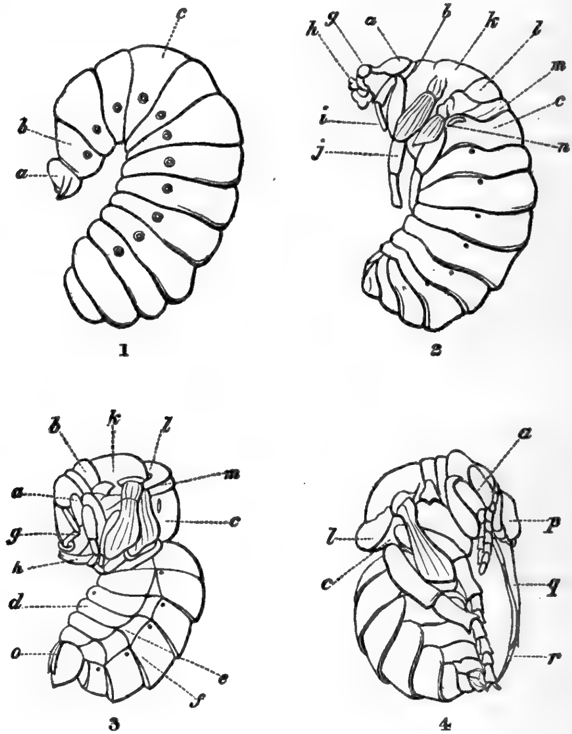
The families of this suborder differ more among themselves than those of other suborders, by reason of the lowness of their type, presenting an unusual number of degradational forms, the connecting links of which have become, we must believe, extinct. The Neuroptera are moreover true synthetic types, combining, as do all decephalized embryonic forms, the structure of several equivalent groups, presenting features which remind us of characters more fully wrought out in higher and more compactly finished groups of Insects.

DESCRIPTIONS OF THE FIGURES.

Fig. 1. *Bombus fervidus.* The first stage of the semipupa, concealed by the larval skin. The semipupa head lies under the head (*a*) and and the prothoracic ring (*b*). The basal ring of the abdomen (*c*), or fourth ring from the head, is unchanged in form. This figure also will suffice to represent the larva, though a little more produced anteriorly than in its natural form.

Fig. 2. *Bombus fervidus.* The second stage of the semipupa. The larval skin entirely sloughed off, the two pairs of wing-pads lying parallel, and very equal in size, like the wings of Neuroptera,

the thoraco-abdominal ring, or propodeum (*c*), with its oblong spiracle (*n*), essentially differing from those on the abdomen. At this point the body contracts; but the head and thorax together are yet, as still more in the previous stage, much smaller



than in the pupa, and there is still a continuous curve from the tip of the abdomen to the head. *g*, antenna; *h*, lingua and maxillæ and palpi; *i*, fore legs; *j*, middle legs; *k*, mesoscutum; *l*, mesoscutellum; *m*, metascutellum; *n*, spiracle of the propodeum.

Fig. 3. *Bombus fervidus*. The third stage of the semipupa. The head and thorax together now nearly equal in size the abdomen; the propodeum (*c*) has become entirely transferred to the thorax. The head has become greatly enlarged; the wings are very unequal, the hinder pair are much smaller, and overlain by the anterior pair; the three terminal pairs of abdominal rings, so large in fig. 2, have been absorbed, and partially enclosed in the cavity of the abdomen; and there has been a further differentiation of the ring into the sternite (*d*), pleurite (*e*), and tergite (*f*). *a*, eye; *h*, lingua; *o*, ovipositor, two outer rhabdites exposed to view. The abdominal spiracles in figs. 2 and 3 are represented by a row of dots. In the pupa (fig. 4) they are concealed by the tergites.

Fig. 4. *Bombus fervidus.* The pupa state, where the body has become much shorter, the appendages of the head and thorax greatly differentiated, the external genital organs wholly retracted within the cavity of the abdomen, the head freer from the body, and the whole bulk of the head and thorax together, including the appendages, greater than that of the abdomen. *c*, the propodeum, nearly concealed in a side view; *p*, labrum; *q*, maxillæ, with the two-jointed palpi at the extremity; *r*, tip of the lingua.

XVI.—*On some Cetaceans.* By Hermann Burmeister.

(*From a Letter to Dr. J. E. Gray.*)

[Plate IX.]

The Museum has received another new species of Cetacea since my letter; it is a new *Orca*, which I name *O. magellanica*, and now send a figure of the skull with a description. The species is nearest to *O. capensis*, but more slender and different in many respects, as you will find by comparing my figure and description. The animal was found on the shore, near the mouth of the small river called "Arroyo de Cristiano muerto," in S. lat. 38° 50′, and was in a perfect state of preservation; but, by the negligence of the people who found it, the whole skeleton was lost, with the exception of the skull and two vertebræ (one dorsal, one caudal) which have come into my hands.

From your Catalogue I learn that you do not know the skull of the adult Sea-Lion or that of *Arctocephalus Falklandicus.* We have both in the Museum, these two species being the only ones which are found in the Atlantic, near the mouth of the Rio de la Plata. They were formerly very common on the small islands north of the mouth of the river, named from them "Islas de los lobos," *lobo marino* (sea-wolf) being the Spanish name for a Seal; and not unfrequently they come into the mouth of the river even as far as Buenos Ayres, where I have already twice seen full-grown living specimens of *Arctocephalus Falklandicus.* Both of these were, I believe, carried to France; but perhaps they died on the voyage. They were kept here for a long time in a large basin of fresh water; and I was one of the daily visitors to these very interesting animals*.

We have in the Museum a young half-grown specimen nearly 3 feet in length. From this I have taken the skull, of which I now send you a description and drawings (Pl. IX. fig. 1 from above, and fig. 2 from the side, one-half natural size; fig. 3, end of the palatine bones, natural size; and fig. 4, some teeth, seen from the inside, also natural size. The numbers indicate the

* I have no doubt it is one of these that is now alive in the Zoological Gardens in the Regent's Park.—J. E. G.

position of the teeth—2nd, 3rd, 4th, and 5th molars). The skull is not very flat, and has no crest; the upper surface is rounded and the orbits very large, with a sharp spine on the anterior, and a horizontal crest on the upper margin. Teeth $\frac{6}{4}$ I. and $\frac{6-6}{5-5}$ M.; the two outer incisors in the upper jaw are much more prominent and of a conical form, like the canines; but the other four are smaller than those in the lower jaw; the upper with two points, one before, the other behind, of equal size; the lower with a transverse obtuse margin, somewhat higher than the outer edge. The canines have not attained their full size. Of the six upper molars, the first four descend perpendicularly, the other two are sloping, with the apex backwards; each of them has a large conical crown, with a small acute tubercle on the anterior margin of the base, and the three last have another more elevated tubercle on the posterior part of the crown. In the lower jaw there are only five molars; but, as the last in the upper jaw is entirely white, and the others all brown and less developed, it is possible that a sixth molar might subsequently have been developed in the lower jaw. Each of the five lower molars has a small tubercle in front, at the base of the high conical crown; and the three hinder ones have also a more highly developed tubercle on the posterior part of the crown, which becomes higher and larger posteriorly. The palatine bones are deeply excavated anteriorly, and flat behind. The hinder margin is retracted forward in the middle, and has on each side an obtuse prominent angle, as shown in my drawing. The occipital condyles are wanting, and therefore only indicated in my figure.

On Tursio Eurynome.

The skull of the Dolphin in our Museum which I have called *Delphinus Euphrosyne*, perhaps by a change of the very similar names, is not *D. Euphrosyne* of the 'Voyage Ereb. and Terror,' pl. 22, but *D. Eurynome*, ibid. pl. 17, now named *Tursio Eurynome* in your Catalogue, p. 261. The skull agrees exactly with your figure, and cannot belong to a different species. The lower jaw is wanting, and both sides of the upper jaw want the tops; in the remaining parts there are twenty orifices or sockets for the teeth, wanting the five of the top, with that part of the maxillary bones; but as the intermaxillaries are completely preserved, I can hardly be in error as to the portion wanting of the maxillaries. The skull is very old, and may have been brought by a vessel from the East Indies to Buenos Ayres; but as it is very rare for any one here to take an interest in the preservation of such things, I supposed that it must have been obtained in this country.

On Delphinus microps.

Of this species we have now three skulls in the museum, it being the commonest species on the coast of Brazil south of the equator. I saw many troops of them during my voyage in the sailing vessel which first brought me here.

The animal is of the size and colour of your *Delphinus Walkeri* (fig. 100), and I think it may be the same species, if the skull is not very different. My three skulls are of equal size, 17 Rhenish (=18·15 English) inches in length, and 7 (=7½ English) inches in breadth at the widest point on the temporal arch, beneath the *fossa temporalis*. They have from forty-seven to forty-nine teeth in the upper jaw, and from forty-four to forty-eight in the lower; but the number seems to be variable, as the first and last teeth are very small, and often wanting on one side when present on the other. The upper jaw always has some more teeth behind, and the lower jaw probably some more in front. The form is exactly like your figure (pl. 25), even the deep groove on the right side of the frontal tubercle being the same, and the occipital crest very prominent in front, perhaps more so than in your figure. The teeth are six to an inch in the middle of the jaw.

In its general form the skull is nearly allied to that of *Steno attenuatus*, which I received last year from a friend on his return from Europe in a sailing vessel. This vessel took the animal in the middle of the Atlantic, south of the line; and my friend preserved the skull for me, the animal having been eaten by the sailors. The skull is exactly 17 inches long, and agrees precisely with your figure in the 'Voyage of the Erebus and Terror,' pl. 28.

Lastly, I have also received the skull of *Delphinus Styx* (Voy. Ereb. and Terr. pl. 21) from a sailor, who captured the animal near Madeira. I am also in expectation of an entire well-preserved skeleton of a Dolphin taken in the river two miles above Buenos Ayres; but the owner would not give me the bones till to-day.

Orca magellanica, n. sp. Pl. IX. fig. 5.

This animal is known only by a skull found on the shore of the province of Buenos Ayres, in lat. 38° 50′ S., near the mouth of the small Rio del Cristiano muerto. It seems to be very like *Orca capensis*, but rather more slender, as is proved by the following measurements of the skull, compared with the same in *Orca gladiator* and *capensis*, as given by Dr. Gray in his 'Catalogue of Seals and Whales, ed. 2. pp. 280 & 284.

	O. gladiator.	O. capensis.	O. magellanica.
Length, entire	33	36½	36
Length of nose	19½	18	19
Length of teeth-line	14½	14	15
Length of lower jaw.........	27½	29	30
Breadth at notch	10½	12	10½
Breadth at orbits	18	21	20
Breadth of temple............	18	20	18
Breadth at middle of beak	9½	10	10
Breadth of intermaxillaries	...	3½	4½
Breadth in front	4	4½	4¾
Breadth in middle	3½	3¼	4

These measurements show that the beak is longer than in the Cape species, and relatively shorter than in the European species, but perhaps of the same breadth; the teeth-line is longer than in either of them, and the after part, between the orbits and temples, rather smaller and not so broad. Other differences are presented by the forms of the different bones.

The intermaxillaries, which in *Orca gladiator* are narrowed to the apex, and in *O. capensis* are enlarged into an ovate figure (as shown by the drawings in the Voy. Ereb. and Terr. pls. 8 & 9), have a more rounded form in *O. magellanica,* and are broadest at the apex; from that point they go in a straight line to the base of the nose, only becoming rapidly narrower near the notch, where the breadth is only 3½ inches (at the anterior extremity 4½), and then are extended into the usual elliptical part surrounding the nasal apertures. In consequence of this breadth of the intermaxillaries in the anterior region, the maxillaries are slender, and narrower than in the other two species.

In the form of the occiput *Orca magellanica* agrees rather with *O. capensis* than with *O. gladiator,* being larger and having a somewhat excavated surface, and a sharp crest on the whole circumference above. This crest has in the middle a posteriorly protracted angle, into which enters the high protuberance of the frontal bones behind the nasal apertures; from the edge of this angle a sharp elevated margin or line descends along the middle of the occiput to the great occipital foramen. The sides of the occiput are sloped more backward, as in *O. capensis,* and thus form a larger posterior temporal cavity. The tuberosity before and above the orbits seems to be not so high; but the lower angle of this tuberosity in front of the entrance into the orbit is much sharper and more descendant, and the small notch in the middle of the upper margin of the orbit is somewhat broader; but the form of the entrance of the orbit is exactly the same as in *Orca capensis.* The postorbital process also shows some dif-

ferences: it has the same figure as in *O. capensis,* but is somewhat thickened only at the lower margin, whilst the upper part, near the suture with the maxillary bone, is deeply excavated, so that the suture is even more elevated than the bones beneath it.

The *fossa temporalis* resembles that of *O. capensis* in form, and is much more elongated than in *O. gladiator*; it is acute in front and rounded behind. It is 10 inches long, 4 inches broad in the middle; the lower margin is of a sigmoid form, and has a stronger protuberance over the region of the ear than in *O. capensis*; but the hinder part of the occiput, corresponding with the mastoid process of higher animals, is not so strong as it seems to be in *O. capensis,* and is somewhat shorter.

The tympanic bones are wanting, and the articular cavity for the lower jaw is strongly excavated, with a prominent lower margin.

The number of teeth is twelve in each jaw; each of them is situated in a large socket, the first sockets being somewhat smaller than the following ones. In front of the first socket, in the intermaxillary bone, there is a small and not very deep groove, in which there has probably been a small tooth, now wanting. The total number of teeth would then have been thirteen in the upper jaw.

Each tooth is of a conical form and somewhat curved, with the apex backward, and the anterior margin more perpendicular than the somewhat inclined posterior margin. The upper half of the crown is whitish, the lower half brown; on the former there is a thin layer of enamel, which is wanting on the lower brown portion.

Buenos Ayres,
May 5, 1866.

Your sincere Friend,
H. Burmeister.

XVII.—*Notulæ Lichenologicæ.* No. VIII. By the Rev. W. A. Leighton, B.A., F.L.S.

NEW BRITISH LICHENS.

The following additions to our British Lichens are made by Dr. W. Nylander in the 'Flora' for February 1866, p. 85.

1. *Lecidea chlorotiza,* Nyl.

Thallus cinereo-virescens, tenuis, subleprosus, effusus; apothecia carneo-flavida, convexiuscula vel convexa (latit. 0·4–0·6 millim.), immarginata (solum juvenilia margine obtuso), intus incoloria; sporæ 8næ, incolores, oblongæ vel oblongo-fusiformes, 1-septatæ, longit. 0·009–0·012 millim., crass. 0·002–

0·003 millim. (rarius simul subbacillares et longitudinis usque 0·014 millim.); paraphyses gracilescentes vel non bene discretæ; epithecium, hymenium et hypothecium incoloria. Gelatina hymenea iodo cærulescens, deinde mox violacee tincta vel violaceo obscurata.

Ad corticem ulmi prope Clifton in Anglia, 1865. (C. Larbalestier, Esq.)

Facie est *Lecideæ luteolæ*, var. *chloroticæ*, Ach., sed affinitate accedit ad *L. globulosam*, Flk.

2. *Verrucaria antecellens*, Nyl.

Similis *V. epidermidis* f. *tremulæ*, sed sporis (ovoideo-oblongis, 1-septatis) multo majoribus, longit. 0·032–0·035 millim., crassit. 0·009–0·011 millim.; paraphyses graciles vel vix ullæ.

Ad corticem Ilicis in Anglia (Tilgate Forest, Sussex) legit Larbalestier.

Varietas sit *V. epidermidis*. Apothecia conferta, sat parva.

3. *Lecidea dispansa*, Nyl.

Lecidea expansa, Nyl. in Leight. L. Br. Exs. 186, memorata in 'Flora' 1865, p. 355, non omnino eadem est ac Americana corticola *L. myriocarpoides*, Nyl. in litt. ad Tuck; hoc corrigere liceat ex examine accuratiore. *L. myriocarpoides* thalamium habet dilute lutescens et epithecium luteo-fuscescens; in dicta *L. expansa* thalamium est subincolor, epithecium nigricans; etiam thalli et hypothecii differentiæ obveniunt. Ob nomen *expansa* alii ante datum a Chevalier mutandum, proponere liceat ejus loco novum. Dicatur tum nostra *expansa* posthac *Lecidea dispansa*. Male ad hanc *dispansam* relata fuit *L. sylvicola*, Flot. Krbr. Lich. Sel. 75, cui apothecia vulgo convexa, thalamium (lamina tenui visum) cærulescens, epithecium non obscuratum, hypothecium medio nigricans, gelatina hymenea iodo vinose rubens, spermatia tenuiora, etc.; ita differentiæ plurimæ.

On the Cephalodia in Peltidea venosa. By Dr. W. Nylander. (Flora, 1866, p. 116.)

Dr. Nylander has at various times in his writings pointed out the existence of cephalodia of divers sorts upon Lichens. On the upperside of the thallus granuliform cephalodia occur in *Lecidea panæola*, placodioid ones in *Placopsis*, fruticulose ones in certain *Stictei*, besides others in *Stereocaulon*, *Usnea*, &c.

On the lower surface of the thallus peculiar pyrenodine ("ob formam imitantem apothecia pyrenocarpea obtecta") cephalodia are present in some *Stictei* and in *Nephroma expallidum*.

He now makes known those which he has recently discovered on the lower surface of the thallus, and most frequently on the fuscous tomentose nerves of *Peltidea venosa*. These cephalodia are granular, cartilaginous, glaucous or glauco-cinereous (at length becoming dark or blackish), small (commonly 0·2–0·5 millim. broad), superficial, subglobose or somewhat depressed, not unfrequently clustered. They contain granula gonima, of moderate size and moniliform, in a thin cellular texture.

GONIMIA, LEPTOGONIDIA, OR GONIDIMIA.

Dr. Nylander (*l. c.*) suggests that it may be advisable to call the *granula gonima* by the term "*gonimia*," to distinguish them from true *gonidia*. Perhaps, also, the gonidia of peculiar type which are observable in *Peltidei, Solorinæ, Nephroma expallidum*, and which are of small size and furnished with a thin cellular wall, may deserve a distinct name, which he proposes to be "*leptogonidia*" or "*gonidimia*."

CLADONIA, CLADINA.

Dr. Nylander (in Flora, 1866, p. 178) proposes to divide the genus *Cladonia* thus:—

Those species which have a thallus leafy or squamaceo-foliolose at the base, and podetia (with a cortex partially split up and powdery) often more or less furnished with leaflets or scales, and still oftener more or less scyphophorous, he retains in the genus *Cladonia*.

Those species which have a leafless thallus, podetia commonly without scyphi, branched, the branches sharply pointed, a cortex not splitting up, and powdery (although sometimes evanescent, and thus denuding the subarachnoid stratum medullare), he comprises in a new genus, *Cladina*. In this he arranges *C. rangiferina, peltasta, uncialis* (et *amaurocræa*), *medusina, candelabrum, gorgonea, Salzmanni, divaricata, leporina, aggregata, retipora, schizopora*, and perhaps also *papillaria*.

Cladonia furcata and its allies approach to *Cladina*, but differ by possessing leaflets.

SPERMOGONIA.

To show the value of the spermogonia as a distinctive character, Dr. Nylander states (*l. c.* p. 181), "*Platysma subperlatum*, spermogoniis neglectis dignosci fere non potest a *Parmelia latissima*; *Platysma commixtum* vix nisi spermatiis distat a *Platysmate Fahlunensi*; *Physcia adglutinata* similiter distincta a *Physcia obscura*, quarum (spermatiis non examinatis) ante juncta fuit ut varietas."

IODINE.

Dr. Nylander says (*l. c.*), "D. Fries affert me reactionem iodo effectam attulisse tanquam signum Lichenes omnino a Fungis distinguens, etsi eam nunquam aliter eo respectu proposui quam sicut adminiculum accedens in certis casibus, ubi dubium restitit in formis Lichenaceis infimis a Fungis simillimis distinguendis."

XVIII.—*On the Reproduction and Embryogeny of the* Aphides. (Third Note.) By M. Balbiani*.

Having described in my two previous communications the phenomena presented by the viviparous *Aphides* in their reproduction and development, I now come to the examination of the same facts in the oviparous Aphides, which represent the last generation produced by the preceding individuals towards the close of the year. This autumnal generation consists, as is well known, of males and females, which copulate, when the females lay eggs which pass through the winter and are hatched only in the following spring.

The oviparous *Aphides* are produced under conditions exactly similar to those which governed the development of the viviparous forms. Not only does the embryo originate in an ovule differing in no respect from that producing the latter, but all that I have said with regard to the first modifications of the ovum, the formation of the blastoderm and embryos, and the production of the male and female generative elements is perfectly applicable to them. From this it results that these animals, which, after their birth, will give the most manifest signs of the separation of the sexes, appear during a great part of their embryonic existence like truly hermaphrodite creatures, which it would be impossible to distinguish from their oviparous [?viviparous] congeners. It is only when their development has become considerably advanced that the first tendency to the separation of the sexes is manifested. How this separation is brought about, is what we shall now proceed to examine.

Of all the means at the command of nature for the attainment of this end, the most simple would evidently be to affect with atrophy one of the sexual apparatus, the other continuing its normal development. But this is not what takes place. The male apparatus does not disappear, and is found, after birth, in individuals of both sexes, with characters scarcely differing from

* Translated from the 'Comptes Rendus,' June 25th, 1866, pp. 1390–1394. See Annals, ser. 3. vol. xviii. pp. 62–69.

those which it presented in the viviparous *Aphides* *. All the transformations, therefore, affect only the female apparatus, which, according to the sex which the embryo is to possess, retains its primitive character or undergoes such modification as to become a true testis.

The changes which this organ undergoes in order to become a well-characterized ovary, such as we meet with in the female when adult, are reduced to a simple growth of all its parts, the form and arrangement of its elements not presenting any fundamental difference from those which they present in the viviparous individuals. We may then recognize in it, in a most evident manner, the mode of grouping of the cells in the ovarian chamber which I have described in the latter.

When, on the contrary, the female element of the hermaphrodite apparatus is destined to become a testis, the small cellular masses surrounded by a proper envelope of which it consists become converted into so many fusiform capsules or follicles containing rounded masses composed of numerous small cells, which are only the developmental elements of the spermatozoids of the male. In the embryo these capsules form at first two groups symmetrically placed in the two halves of the body; but after birth they become confounded into a single group by their coalescence in the median line. At the period of reproduction these capsules are found to be filled with long filiform spermatozoids arranged in parallel bundles, as in other insects.

I have already stated that the embryonic male organ occurred almost without any modification in individuals of both sexes after birth. It is easy, in fact, to ascertain that this is the case by the existence of the two cellular cords (of a green colour in most species), which are found arranged in the same way as in the viviparous individuals, both in the females and males—that is to say, in the interior of the ovaries in the former, and in that of the testes in the latter. The persistence of this element in animals in which the separation of the sexual functions in different individuals is shown so evidently, does not, at first sight, appear to be capable of explanation except by that familiar tendency of nature to retain a part, even when it is of no use to the organism, and solely to recall a typical or primitive condition. It is, in fact, difficult to interpret otherwise its preservation in the male, where it appears to be supererogatory to the well-

* I shall have, on another occasion, to explain my notion of the nature of this male embryonic organ, which must not be confounded with an ordinary testis. I have found its analogue in several other animals, the phenomena of reproduction in which, hitherto enveloped in obscurity, have led to their being classed among the species which are propagated by parthenogenesis.

developed testis; but in the female it is otherwise, and we shall see, in speaking of the development of the egg, that its presence in this sex has a much more important signification.

The conditions which influence the determination of the sexes in the *Aphides* are probably of the same kind as those which act in a more general manner to bring on a change in their mode of propagation; that is to say, they are probably dependent upon the phenomena of nutrition in these insects. The following observations support this opinion.

At the period when the production of the diœcious generations commences we find that at first females are almost exclusively generated, the males being still comparatively rare. But the latter soon become more and more numerous, and at last are even produced in greater abundance than the female individuals. A single hermaphrodite mother may, moreover, contain at the same time embryos of both sexes, succeeding each other without apparent order in the interior of her ovarian sheaths. It is curious to observe the difference of coloration of the male and female embryos of the same species. The latter alone present a colour which resembles that of their mother: thus, for example, in a species of which the viviparous individuals are brown, the oviparous females are also brown, whilst the males are constantly green*, and *vice versâ*. This difference of colour is due to the oleaginous globules which fill the cells of the fatty body, and is, no doubt, connected with a different chemical composition of the nutritive fluids in the embryos of the two sexes.

After this brief exposition of the embryogenic phenomena connected with the determination of the sexes in the Aphides, it remains for me, in order to traverse the whole reproductive cycle of these animals, to describe in few words what I have been able to observe of the development of the ovum destined to reproduce the viviparous generations with which we commenced this investigation. Notwithstanding the considerable differences as to its elementary constitution and the conditions of its development presented by the voluminous ovum of the oviparous *Aphides* when compared with the little ovule of the viviparous individuals, there is nevertheless a striking analogy in the phenomena of which both are the seat. Although the formation of the embryo does not commence in the former until after it has been fecundated by the male and brought into the world, it nevertheless, whilst still enclosed in the ovary, exhibits phenomena which indicate that genetic operations have already begun in its interior. Thus we observe, at the posterior pole of this

* At least in the embryonic and larval states; the adult male is almost always blackish.

ovum, a rounded mass composed of a group of small, pale, and scarcely visible cells, enclosed in a common envelope, which become more and more apparent in proportion as the egg approaches the term of its maturity. At this moment it is impossible not to recognize in these elements the analogues of the spermatic cells of which I have described the mode of formation in speaking of the development of the viviparous *Aphides*. These cells, indeed, present all the characters, even to the green coloration due to numerous small pigment-granules, which I have indicated in the latter; and we may also recognize in them even the little daughter cells in which the seminal corpuscles will afterwards be developed. These facts evidently indicate that the egg has already, while in the ovary, undergone a first fecundation, with which the male has nothing to do, and the effect of which is limited to the production of the generative elements of the future animal. Now the agents of this fecundation are nothing but the seminal corpuscles developed in the hermaphrodite apparatus of the embryo, and which are transmitted by the latter to the adult female.

After fecundation by the male, and the deposition of the egg which succeeds this, the embryogenic work, properly so-called, commences. The blastoderm appears in the form of a continuous layer of cells surrounding the whole surface of the egg. This blastoderm opens widely at its posterior part, and the mass of spermatic cells penetrates towards the middle of the vitellus. A wide canal, which extends from the posterior pole to the centre of the egg, marks this passage for some time; then the orifice of the blastoderm closes, and the walls of the canal are effaced. But, unfortunately, the egg, which, while these phenomena are taking place, has acquired a darker tint at its anterior pole, due to the coloration of the chorion, soon becomes covered from one end to the other by a blackish veil, which conceals from the observer the further phenomena taking place in its interior.

XIX.—*Note on some new Genera of Fossil Birds in the Woodwardian Museum.* By H. Seeley, Esq.

TERTIARY BIRDS.

Ptenornis.

Sternal end of a right coracoid from the Lower Tertiary of Hempstead, Isle of Wight. It has much the size and form seen in the Mute Swan; but the exterior angle is rounded and thickened, as in *Bubo*. The bone is compressed; the sternal articulation is convex. There is nothing to show whether the

bird was raptorial or natatorial. It bears evidences of having been eaten.

Macrornis tanaupus, Seeley.

Proximal end of right tibia of a large Struthious bird from Hordwell. It is as large as the Emu, but is further removed from the Emu than the Ostrich, in the struthious direction. Both pairs of sides are subparallel. The patelloid prominence arises from a narrower base than in the great Struthionidæ, and is produced into a considerable process on the inner side of the leg. There is an inflation at the back of the proximal end. The shaft is compressed, and the fibula-ridge is sharp. The points in which it is unlike known struthious birds are those which characterize some genera of waders and gallinaceous birds.

Megalornis, Seeley.

Lithornis emuianus, Bowerbank, Ann. Nat. Hist.

Cast of original specimen in the British Museum; and distal end of a right tibia exactly corresponding to it, from the London Clay of Eastchurch, in the Isle of Sheppey. Taking the Ostrich as a type, this bird diverges from the typical Struthionidæ on the other side of the Emu, yet appears to conform to the Casuarine allies. The shaft is set on to the extreme back of the trochlear end, and is more robust than in the Emu. Also its posterior side is more rounded, and the inner side more angular.

CRETACEOUS BIRDS.

Mr. Lucas Barrett, in 1858, discovered bones in the Upper Greensand which he recognized as those of a bird allied to the Natatores. They are described, in Sir C. Lyell's Supplement to the fifth edition of the 'Elements,' as rather larger than those of a common pigeon. And Prof. Owen, in the second edition of the 'Palæontology,' speaks of a trifid tarsus showing the *outer* toe-joint much higher up than the other two. Of neither of these are there any examples at Cambridge. But we have collected or seen a number of cervical, caudal, and dorsal vertebræ, proximal and distal ends of tarsal bones, proximal ends of tibiæ, proximal and distal ends of femora, humeri, metacarpal bones, &c., which demonstrate the existence of a very distinct genus of birds in the Cambridge Greensand, of which I have named the typical species *Pelagornis Barretti*.

Descriptions of these new genera will appear in the 'Catalogue of Fossil Vertebrata in the Woodwardian Museum.'

XX.—*On the Fossils of the Carstone Formation.*

To the Editors of the Annals of Natural History.

Gentlemen,

In April the 'Geological Magazine' contained a short paper on the phosphatic nodules of Bedfordshire, which I first observed in company with my friend Mr. Knowles, of Emmanuel College, several years ago, when the cuttings for the Bedford Railway were being made. Both before and ever since then I have been gathering material for a memoir on the Carstone and its southern extension, in which this phosphate-bed is found; but I should not have been tempted to refer to the bed yet, had not the paper in the 'Geological Magazine' called forth another, from an old friend, which you have inserted in the last Number of your Journal.

The author of the former paper asserts that "every organism of this phosphatic bed is evidently extraneous, and probably was derived from the destruction of the Oxford and Kimmeridge Clays and intervening Coral Rag, from which the phosphatic matter must have been obtained, while the Lower Greensand was in process of formation."

To any one who knew the fauna of the bed in question (the Carstone) this would seem remarkable; for, instead of every fossil being extraneous (and I have *dozens of genera*), I have never obtained one that is extraneous: they all appear to me denizens of the old sea-bed where they abound. The multitudes of Saurians are chiefly Cretaceous species; and among the shells I seek in vain for fossils from the Oxford or Kimmeridge Clay, or for blocks of Coral Rag. The *Gryphæa dilatata* is perversely wanting; the *Ostrea deltoidea* cannot be found; the Ammonites will not answer to any of their Oolitic names, or show a trace of iron pyrites. And yet when fossils endurable like these, and abundant, are wanting, it is imagined that the fragile and very rare argillaceous casts of shells—no firmer than the clay they rest in—have withstood with impunity ages of buffetting on a gravelly beach.

The truth is, the "Sandy nodule bed," as this bed in the Carstone may be called, reproduces, earlier in time, the conditions of the Cambridge Greensand. There are specimens in it of other rocks in hundreds; but they are old rocks, like those the Carstone was derived from.

And if the fossils had been extraneous specimens from a clay, it would have been no more astonishing to have found that the alumina, magnesia, and fluorine in the nodules only make up 4 per cent. together than to have discovered Oxford or Kim-

meridge Clay, or even Coral Rag, so stored with phosphoric acid that its denudation would furnish nothing but a magnificent crop of nodules of phosphate of lime, like these.

The wood which occurs in the bed is like that which occurs in the Gault of the southern counties and Carstone here, and is mineralized with phosphoric acid, and therefore no more requires an appeal to extensive denudation of Purbeck beds to account for it than the occurrence of remains of *Iguanodon* can be held to prove denudation of Wealden beds; for the chief fame of that beast is from its occurrence in the Shanklin Sands in the Iguanodon quarry.

Like the Cambridge Greensand, the deposit offers many new facts of interest in the distribution of life. Thus *Pliosaurus,* so characteristic of Oxford Clay, Coral Rag, Kimmeridge Clay (and probably Portland), is now found in the approximate equivalent of the Shanklin Sands. *Dinotosaurus,* a new genus of the Oxford and Kimmeridge Clays, also abounds here, and thus, like *Ichthyosaurus, Plesiosaurus, Megalosaurus,* &c., helps to connect into one great life-system the lower and the upper Secondary Rocks.

I am, Gentlemen,
Faithfully yours,
H. Seeley.

Sidney Sussex College, Cambridge.
July 17, 1866.

XXI.—*Description of* Calamoichthys, *a new Genus of Ganoid Fish from Old Calabar, Western Africa.* By John Alexander Smith, M.D., F.R.C.P.E.; with *Observations on the Internal Structure,* by R. H. Traquair, M.D., Demonstrator of Anatomy in the University of Edinburgh*.

In the beginning of January 1865, the author received from the Rev. Alexander Robb, Old Calabar, a package of specimens of natural history preserved in spirits. Among these were two small ganoid fish. They were, however, imperfect, having been torn across near the anal region, and their caudal extremities were wanting. The characters of the fish could not, therefore, be completely determined. The author, however, exhibited them at a meeting of the Royal Physical Society, on the 22nd March, 1865, and stated that they were allied to the genus *Polypterus*; but from various differences in character, to be afterwards detailed, and especially the great relative length of their bodies, and the apparently total absence of ventral fins, he would place them in a new genus, which, from their general aspect and form,

* Communicated by Dr. Smith, from the Proceedings of the Royal Society of Edinburgh.

he designated *Erpetoichthys**, the reptile- or serpent-fish; and the species, from the locality where it was found, he named *E. calabaricus*.

Since that time the author had received perfect specimens from Old Calabar, and found that the accuracy of his previous conclusions were confirmed.

The fish is got in the freshwater streamlets which run into the main rivers or creeks of the great Calabar River, and in the pools of the marshy lands. It is occasionally sold in the markets, and eaten by some of the natives. Its native name is *U-nyăng*, which the Rev. Mr. Robb explains by suggesting that it may be derived from a verb signifying to struggle or scuffle for the possession of a thing, and he therefore supposes it to mean the struggler, or, using a Scottish word as more appropriate, the "wambler," the name being probably given to it on account of the apparent struggling, wriggling, or undulating movements of its elongated body as it swims in the water or mud of the river.

Summary of characters of the genus *Calamoichthys*, and its relation to the genus *Polypterus*:—

Genus *Calamoichthys*.—*Head* small, depressed above, somewhat oval in shape (rounded and narrow in front, expands laterally behind orbits, and contracts again at the back part, towards neck). Suboperculum wanting. (No small plates below preoperculum.) *Body* much elongated, anguiform (cylindrical for about half its length, then becoming gradually more compressed laterally, and tapering slightly towards its caudal extremity). *Caudal extremity* short, tapering rapidly. *Caudal fin* rounded, homocercal; fin-rays hard. (*Scales* osseous, rhombic, sculptured.) *Fins* small; pectorals obtusely lobate; fin-rays soft; dorsal finlets numerous, separate; anal (with fulcrum at base anteriorly) in male large, in female small; fin-rays hard; ventrals wanting.

The last character is rather an important one, as this fish thus appears to be the only living ganoid yet known which has no ventral fins. Van der Hoeven, in his 'Handbook of Zoology,' gives the presence of ventral fins as one of the characters of his great Section III. of the class Pisces, the *Ganolepidoti*; and older naturalists, as Cuvier, place the Ganoids, for a similar reason, among the *Malacopterygii abdominales*. The discovery of this fish will therefore necessitate a change in this character of the whole section.

* Since this paper was sent to press, the author has learned that a closely corresponding name to *Erpetoichthys* had been already used in ichthyology; and accordingly he now changes the designation to *Calamoichthys* (κάλαμος and ἰχθὺς), which still bears a relation to the cylindrical shape of the fish.

In the genus *Polypterus*, on the other hand, the *head* is relatively larger (with apparently little or no lateral expansion and subsequent contraction towards the neck); its gently swelling outlines gradually expand and run backwards into those of the body. Suboperculum present; several small plates below preoperculum. *Body* relatively much shorter, generally tapering gradually from behind region of pectoral fins, and becoming more compressed laterally towards its caudal extremity. *Caudal extremity* longer. *Scales* generally smooth (?). *Fins* larger; pectorals, fin-rays osseous; anal apparently alike in size in male and female; ventrals present.

The genus *Calamoichthys* agrees, however, with *Polypterus* in the general character of its numerous dorsal finlets; lobate pectorals, two nasal cirri, a spiracle on each side of the head above, and a large flat branchiostegous ray, or jugular plate, on each side of the mesian line below; and also in the hard, osseous, rhomboidal-shaped ganoid scales, arranged in rows running obliquely backwards, and in the tapering caudal extremity of the body.

The new genus belongs, therefore, to the same family as *Polypterus*, and would accordingly fall to be placed next to it in the family of the Polypterini.

Family **Polypterini.**

I. Genus Polypterus.

II. Genus Calamoichthys.

1. Species *C. calabaricus.*

(The specimens described measured from 8 to nearly 13 inches in length.)

Hab. Old Calabar River, and the Camaroons, West Africa.

(A female sent by Mr. G. W. Mylne from the latter locality, and recently received by Dr. Smith, was also exhibited.)

On dissecting those specimens of *Calamoichthys* entrusted to the author by Dr. Smith, the greatest similarity was found to exist between their internal organization and that of *Polypterus*, the chief differences being dependent on the great elongation of the body of the former fish, while the abdominal cavity extends proportionately still further back towards the caudal extremity than is the case even in the genus last mentioned.

The vertebræ resemble in construction exactly those of *Polypterus*, but are very much increased in number, amounting, in the specimen which was used for the preparation of the skeleton, to 110, the first of which has no body, consisting merely of neurapophyses, spinous process, and a pair of ribs. These latter form

the first of the series of well-developed upper ribs, which extend, in the horizontal intermuscular septum, as far back as the ninety-eighth vertebra. But ribs of the lower series are very deficient in development in comparison with those in *Polypterus,* where the whole series of abdominal vertebræ, except the first, is furnished with those appendages, which posteriorly attain a considerable length. In *Calamoichthys,* on the other hand, those lower ribs are very minute, and no trace of them was found in advance of the sixtieth vertebra. The number of abdominal vertebræ, in the specimen alluded to, is 100, of caudal 10—showing the very great proportional elongation of the abdominal and shortening of the caudal region. The vertebral column projects beyond the last caudal vertebra, as a notochordal continuation or "urostyle" concealed among the rays of the caudal fin. The bones supporting the fins agree in their general conformation with those in *Polypterus,* there being, however, a less ossified state of the radius, ulna, and carpus, while the pelvic bones, along with the ventral fins, are completely absent. The first dorsal finlet is placed opposite the forty-ninth vertebra.

As regards the form and arrangement of the bones of the cranium and face, the most complete correspondence is found with those of *Polypterus,* a space being found, however, below the preoperculum, which, in various species of *Polypterus,* is defended by a variable number of bony plates. The suboperculum is also completely absent. The arrangement of the mucus-canals on the head is similar to that in *Polypterus.*

The arrangement of the muscular system corresponds in the two genera. In *Calamoichthys,* owing to the great increase of the number of vertebræ, the number of transverse segments of the great body-muscle is also much larger. The muscular layer along the belly is very thin.

Viscera.—The œsophagus dilates into a flask-shaped stomach, which terminates behind in a *cul-de-sac.* From the interior part of the stomach, and close behind the entrance of the œsophagus, issues the intestine, which passing first slightly forwards, makes almost immediately a turn on itself, and then proceeds straight back to the anus. A small cæcal appendage, with the apex directed forwards, is seen in connexion with the intestine shortly after its backward flexure; and a little further down, between this and the anus, a spiral valve of about five turns is developed in the interior. The liver was in none of the specimens examined very voluminous, but much elongated, being continued as a narrow stripe the whole length of the abdominal cavity. The gall-bladder is distinct, and opens into the intestine immediately after its flexure, and in front of the cæcum.

The heart is conformed as in *Polypterus,* with muscular bulbus

arteriosus, which is furnished internally with numerous valves, of unequal size. The branchial artery gives off first a large lateral branch on each side, which divides into three for the three posterior gills; the trunk then bifurcates, giving off a branch for the anterior gill of each side. As in *Polypterus*, the posterior gill has only one row of leaflets, and the cleft behind it is wanting. No trace of a "pseudobranchia" was found, an organ likewise absent in *Polypterus*. The spleen is very long and slender, lying closely along the great air-bladder. The air-bladders are two in number, opening by a common orifice into the lower aspect of the throat, behind the gill-clefts. That of the left side is small, being only $2\frac{5}{8}$ inches in length in a fish of 10 inches; it is closely adherent to the side of the œsophagus and commencement of the stomach. That of the other side measures $8\frac{3}{4}$ inches in the same fish, and extends through the whole length of the abdominal cavity, lying closely along the under surface of the vertebral column.

Like the rest of the abdominal organs in general, the kidneys are very slender and elongated; each consists of a number of little lobules, which lie in the concavities on the under surfaces of the vertebral bodies. The excretory duct or ureter lies along the outer border of the organ, and passes straight backwards to unite with the genital duct, and, with its fellow of the opposite side, at the urogenital pore. The ovaries and oviducts correspond exactly with Müller's description of these organs in *Polypterus* (Trans. Berlin Acad. 1844). Each ovary is in the form of a flattened plate, suspended in front of the posterior part of the kidney by a mesentery, is solid, and consists of a stroma imbedding ova of all sizes, up to $\frac{1}{14}$ inch diameter. The oviduct, proceeding forwards from the urogenital pore as a pretty wide tube, crosses beneath the ovarian mesentery, and opens into the peritoneal cavity, on the outer side of the gland, and closely above its lower extremity. The ovaries are not symmetrical in position, one being in advance of the other, so that also one oviduct is longer. In a female measuring $8\frac{5}{8}$ inches the right ovary was $1\frac{1}{2}$ inch in length, its anterior extremity being placed $4\frac{3}{8}$ inches from the top of the snout, and the length of the oviduct $1\frac{7}{8}$ inch, while the left measured $1\frac{5}{8}$ inch, was situated at its anterior extremity $5\frac{3}{8}$ inches from the tip of the snout, and had a duct of $1\frac{3}{16}$ inch. The testes are very minute, and situated very far forwards, each being a small oval body $\frac{3}{16}$ inch in length in a male of 10 inches; and in the same specimen the right one was situated $2\frac{1}{2}$, and the left $2\frac{11}{16}$ inches back from the tip of the snout. A very minute duct runs backwards parallel with and close to the ureter, which it joins near the urogenital pore.

On opening a number of specimens, it was found that all those with a large anal fin were males, while those in which that organ was small were females. The females are, however, to be distinguished from the males by another character, namely the much larger size of the urogenital pore, which is situated immediately behind the anus.

XXII.—*On the Amylaceous Globules of the* Florideæ *and* Corallineæ. By M. VAN TIEGHEM*.

KÜTZING first indicated† the existence in the cells of certain Florideæ of amyloid grains, sometimes endowed with a concentric structure; but in assimilating them to the protoplasmic globules of the green and olive Algæ, in including under the general name of *cellular globules* or *gonidia* the whole of the intracellular formations of the Algæ, however dissimilar they may be, and in ascribing to them, as is implied by this name, a reproductive faculty, the illustrious algologist seems to me to have misunderstood their nature and function. M. Nägeli, also, in his great work on starch-grains ‡, hesitates to pronounce an opinion as to the existence of starch in the Florideæ. His own observations, indeed, showed him, in *Cystoclonium purpurascens*, Kütz., some globules to which iodine communicates a coloration varying from red to brown and violet; but he took them for slightly amylaceous parietal grains of protoplasm, and he remained so uncertain upon this point as to declare, in another part of his memoir (p. 382), that starch-grains are wanting in the Florideæ, and finally to leave to future investigations the care of deciding whether these Algæ do possess starch, and of what kind it is. It is this point that I have undertaken to clear up by a series of observations, of which I have the honour to present the Academy with the first results.

For the sake of clearness I shall take as an example *Halopithys pinastroides*, Kutz., which is found in abundance on our coasts. In the cylindrical and much branched frond of this Floridean, the thickened joints of the axis contain only a finely granular liquid; the joints of the five siphons, on the contrary, and the cortical cells are filled with transparent globules, which are colourless in the interior tissue and of a rosy tint in the peripheral zone, although readily deprived of their colour by alcohol; these are scattered in the liquid which bathes the sections, forming therein white streaks. Their most general

* Translated from the Comptes Rendus, Nov. 6, 1865, pp. 804–807.

† Phycologia generalis, p. 40.

‡ Pflanzenphysiologische Untersuchungen: Die Stärke-Körner, 1858.

form is spherical or ovoid; sometimes they are flattened and discoidal or lenticular in form, sometimes irregular. They are formed by a very distinct colourless or rose-coloured membrane, filled with solid greyish contents, most frequently without any central space, but sometimes with a cavity in the centre, which it is not unusual to see divided into several compartments. The full globules are of two kinds: some, and by far the greater number, have a circular outline and are simple; their contents, apparently homogeneous, are formed of very delicate concentric zones, and give a very clear black cross in the polarizing apparatus; the others, variable in form and aspect, are composite, and show a system of concentric layers and a black cross in each of their compartments, when these are sufficiently large.

The very variable dimensions of these globules is in relation to their degree of development: the ordinary diameter of the well-developed grains is from 0·013–0·015 millimetre; the maximum observed was 0·025 millimetre. Iodine gives them a *reddish-yellow* colour. This tint persists upon all the globules whatever be the quantity of tincture of iodine employed; but when we renew the liquid which bathes the grains in proportion as it evaporates, replacing it alternately by a drop of tincture of of iodine and a drop of water, at the edges of the covering glass, where the osmotic movements produced by an alternate disiccation and humectation with liquids of different densities are most active, we see the globules become altered in a remarkable manner at the same time that their colour changes. Sometimes there appears at the centre a small circular space, which enlarges by degrees, the layers becoming dissolved successively from the centre to the periphery, at the same time that the globule enlarges and becomes discoidal; it is reduced at last to a membrane, which becomes more and more delicate, entire or irregularly torn, and as the granule becomes empty its tint passes to pure violet. In other cases the solution commences by a circle of small holes, which increase radially, remaining separated by solid rays; the centre is at the same time hollowed, and the outer membrane, being unable to yield equally to the inflation, becomes undulated; the globule is then of a fine violet, and presents the aspect of a wheel, of which the nave, the spokes, and the undulated felly are of a deep violet, and the intervals of a lighter tint. In the composite globules, formed of compartments arranged in a circle round a central chamber, the contents of each compartment become dissolved by degrees, the granule swells, becomes of a fine violet colour, and presents the radiated appearance which I have just described, with still more distinctness. This disorganization of the granule with blue coloration may, however, be produced rapidly.

If iodized water be brought into contact with globules placed in alcohol, we see a certain number of the granules situated on the line of meeting of the two liquids suddenly burst, and throw out around them their contents, reduced to the form of very small granules, which become *blue*, whilst the torn membrane is of a pale violet colour.

When heated in water to near 158° Fahr. the globules swell, become partially dissolved, and at the same time acquire a fine violet colour. A drop of sulphuric or hydrochloric acid immediately gives a violet or blue tint to the granules which have been reddened by iodine, but at the same time dissolves them partially, swells them up, and tears them. Potash also dissolves them. Hypochlorite of lime alters them rapidly; in twenty-four hours there remain of most of the granules only the outermost layers isolated from each other; in thirty-six hours all has disappeared. Acetic acid and ammonia have no action upon them.

Thus these globules present all the characters of starch in their form, structure, and optical properties, and in the action exerted upon them by hot water, acids, and alkalies; but they differ from amylaceous grains as these are defined, by their acquiring a red colour with iodine. However, they are easily converted into common starch under the ordinary influences which I have just described, but with the condition that they become disorganized and partially dissolved. This difference, which is not sufficient to warrant the employment of a new name, leads to the supposition that we have to do with a hydrocarbonated principle isomeric with cellulose and starch, but intermediate between them by its cohesion.

After the details into which I have entered with regard to *Halopithys pinastroides*, Kütz., I can only say a few words of the starch-grains of other Florideæ; but I must make special mention of the *Polysiphoniæ*, because the amylaceous formation in them presents a new character, which, indeed, occurs very frequently elsewhere, but less evidently. In *Polysiphonia nigrescens*, Grev., which I shall take as an example, the joints of the axis never contain anything but a finely granular liquid; the flattened cells of the siphons, on the contrary, and the cortical cells each contain a coherent mass of spherical globules, which entirely fills them. These globules, the diameter of which is pretty uniformly 0·007 millim., do not scatter themselves in the liquid which bathes the sections, but the entire masses issue in their cells. By applying pressure to them we may succeed in breaking them up into several fragments; but their elements, which have a strong mutual adherence, do not separate; when their margin is carefully examined, they are seen to be surrounded by a continuous membrane, which is rendered yellow by iodine;

a drop of sulphuric acid renders the globules violet, whilst the envelope remains yellow; the prolonged action of the acid dissolves the granules, and all that remains of the mass is a yellow reticulated membrane, with circular or polygonal meshes, produced by a fold which the membrane sends between the globules of the peripheral layer. A reticulated envelope of the same kind exists also in *Halopithys*; but, the elements not having a strong mutual adherence, it is torn under the knife, and is only met with here and there in fragments carried away by the peripheral globules, which are inserted upon it by small pedicels. I have ascertained its presence in most of the species that I have investigated; it is therefore very frequent, if not universal.

The amylaceous formation which is clearly defined by the two preceding examples, recurs with the same characters in the immense majority of the Florideæ and Corallineæ, as is proved by observations which I have already extended to more than thirty species belonging to twenty-five genera. The differences relate to the mode of distribution of the globules in the tissues, and the form and dimensions of the granules, which I have not as yet found superior to those of *Halopithys*, and which are sometimes scarcely 0·001 millim. I cannot enter here into the details of these observations; but they explain why certain large species, such as *Iridæa edulis*, Bory, which are very rich in this sort of starch, may furnish a nutritive food to the poor inhabitants of our coasts; and at the same time they demonstrate in most of the Florideæ and Corallineæ an abundance of amylaceous matter which may be compared with that of the potato or the cereals.

In the cellular Cryptogamia, starch in grains rendered blue by iodine accompanies chlorophyll; and its production appears to be correlative with the mode of life, which results from the functions of the green matter; where the latter is wanting no starch is found. The preceding observations acquire a fresh interest by showing, in a vast group of cellular plants deprived of chlorophyll and consequently endowed with an exclusively comburant respiration, the formation of a principle very nearly related to ordinary starch, but apparently not identical with it.

Do these globules fill the vegetative cells at all periods of the year? and what is their part in the mode of life of these plants, of which so little is yet known? These are questions which I shall endeavour to solve as soon as circumstances will permit. M. Decaisne has been kind enough to verify the principal results of this investigation, and I beg him to accept my best thanks for having done so.

XXIII.—*Notices of British Fungi.* By the Rev. M. J. Berkeley, M.A., F.L.S., and C. E. Broome, Esq., F.L.S.

[Plates III., IV., V.]

[Continued from p. 56.]

1144. *Glœosporium umbrinellum*, n. s. Maculis irregularibus angulatis brunneis; sporis pallidis.

On fallen oak-leaves. Charmy Down, near Batheaston, Oct. 1865.

Forming minute brown spots; spores binucleate, ·0004–·0006 inch long, supported on long, often forked, sporophores, at length oozing out in the form of a pale irregular tendril.

Plate III. fig. 5. Spores supported on their sporophores; and separate, more highly magnified.

1145. *Sporidesmium opacum*, Cd. Fasc. i. f. 115.

On stumps of wych elm, near St. Catharines, March 31, 1865. C. E. Broome.

When young, forming small, round, cinereous tufts, sparingly scattered over the wood.

This has been received from Mr. Bloxam under the name of *S. fasciculatum*; but it does not agree with Corda's character, "soris effusis."

Plate III. fig. 6. Spores and sporophores, magnified.

1146. *S. lobatum*, n. s. Stipite articulato, deorsum hyalino, sursum in articulos subquaternos subglobosos divisum.

On fir sticks. Lucknam, April 12, 1865.

Forming minute, black, pulvinate tufts. At first simple and strongly swollen above. The upper articulation then divides, and ultimately gives off the spores, which are ·0006 inch long. The whole plant is about ·001 high.

Plate III. fig. 7. Spores in various stages, magnified.

1147. *Puccinia Apii*, Cd. Fasc. vi. tab. i. fig. 11.

On celery, about London, Sept. 1865, destroying the crops. Plants sent down to Cambridgeshire were equally affected. For further notice see Journ. Hort. Soc. n. s. vol. i. 1866.

1148. *Thecaphora hyalina*, Fingerh. in Linn. x. p. 230 (*Uredo Seminis Convolvuli*, Desm. no. 274).

In the capsules of *Convolvulus Soldanella*. King's Lynn, J. Lowe, Esq.

**Stilbum fasciculatum*, B. & Br. no. 492.

This is clearly what is figured by Tulasne as a state of his *Sporostilbe gracilipes*, Carp. iii. tab. 14. figs. 14–19.

1149. *Rhinotrichum repens*, Preuss in St. Deutsch. Fl. 25 & 26, no. 22.

On fallen trunks of trees. Leigh Wood, Oct. 1865. Fineshade, Norths., May 31, 1866. On very rotten oak-branches.

Probably extremely common; but, as it looks like a mere bloom, it may easily escape notice.

1150. *Psilonia discoidea*, n. s. Pallide cervina, dein fusca, disco prolifero; sporis oblongis, margine discreto roseo-alutaceo.

On very rotten rails. Langley, Wilts, Jan.–Feb. 1866, C. E. Broome.

Whole plant 1–2 lines across, variously shaped, orbicular, elongated, flexuous, &c. In the early stage the disk is quite covered by the shaggy coat, which afterwards folds back or cracks, and leaves the stratum of spores naked, precisely as in *Myrothecium*. Spores oblong or, seen laterally, subcymbiform, ·00035 inch long. Our plant, however, wants the gelatinous element of that genus, and is nearer to *Psilonia* than any published genus.

Plate III. fig. 8. *a*. plants in various stages, one of them proliferous, slightly magnified; *b*. portion from edge of a plant, showing the spores on their sporophores; *c*. spores highly magnified.

1151. *Morchella crassipes*, Pers. Syn. p. 621.

On red soil, April 1866, Miss L. E. Lott, at King's Kerswell, near Newton Abbot, Devonshire.

This magnificent fungus attains a height of 9 inches or more, and is remarkable for its grooved stem. It is of a soft, brittle substance, and does not dry well like the common morel. It is, however, sold in the market at Prague for present use, where it occurs in autumn as well as spring. It is well figured in Krombholz's large work, at plate 16. fig. 1.

1152. *Helvella sulcata*, Afzelius in Vet. Ac. Handl. 1783, p. 305.

On the ground. Bowood, C. E. Broome, Oct. 20, 1863.

A small but very neat variety. Spores very broadly elliptic, with a single large globose nucleus, ·0006–·0007 long.

1153. *Peziza* (Helvelloideæ) *phlebophora*, n. s. Cupulis poculiformibus, obliquis, substipitatis, subtiliter pulverulentis, basi venoso-costatis.

On clay banks. King's Cliffe, M. J. Berkeley. Brislington, C. E. Broome.

Cup ½–1½ inch across, often rather oblique, yellow or brownish, springing from a very short stem-like base, from which branched ribs are given off, ending in little pits. Sporidia ·0004 inch long, while those of *P. leporina* are ·0006 with curved paraphyses, and those of *P. onotica* ·0005. Hymenium often venose. Figures are added of the fruit of these species.

Plate III. fig. 9. *a*. *P. phlebophora*, nat. size; *b*. ascus, magnified; *c*. sporidia, highly magnified.

Fig. 10. Sporidia of *P. onotica*, highly magnified.

Fig. 11. *a*. curved paraphysis of *P. leporina*, magnified; *b*. sporidia, highly magnified.

1154. *P.* (Helvelloideæ) *bufonia,* P. Myc. Eur. vol. i. p. 225. On heaps of rubbish by the side of the road. Grantham, Mr. W. Summerby.

Resembling *P. vesiculosa,* but distinguished by the brown hymenium and verrucose cup. Sporidia ·00075–·0008 inch long; in *P. vesiculosa* ·0009.

PLATE III. fig. 12. Sporidium, highly magnified.

**P.* (Humaria) *rutilans,* Fr. Ep. p. 68 (*P. leucoloma,* St. Deutsch. Fl. 32. tab. 17).

It is almost impossible to make out the red Pezizas of the tribe Humaria without specimens, as by far the best characters are derived from the fruit. We have now authentic specimens of this plant before us, and find that our *Peziza humosa* is this species. The sporidia, when perfectly developed, are strongly echinulate, with one or more (rarely two) nuclei, and ·001 inch long.

PLATE III. fig. 13. *a.* ascus with paraphysis, magnified; *b.* sporidia, highly magnified.

1155. *P.* (Humaria) *aggregata,* n. s. Gregaria, confluens, obconica, aurantia, basi albo-tomentosa; hymenio concavo; sporidiis fusiformibus.

On heathy ground. Bewick, Dr. Johnson.

The peculiar crowded habit and fusiform sporidia, ·0008 inch long by ·0003 wide, easily distinguish this species.

1156. *P.* (Humaria) *subhirsuta,* Schum. Sæl. p. 433.

On the ground. Batheaston, C. E. Broome.

Asci linear; sporidia smooth, elliptic, enucleate, ·0006 inch long; paraphyses slightly clavate.

PLATE III. fig. 14. *a.* ascus with paraphysis, magnified; *b.* sporidia, more highly magnified.

**P.* (Humaria) *humosa,* Fr. Ep. p. 71.

This in turn is what is called *P. Polytrichi* under no. 768. Sporidia variable in size, ·0006–·001 inch long, by ·0003–·0005 broad; paraphyses forked. *P. Polytrichi* will still remain for the Scotch plant.

Subjoined are sketches of the fruit of *P. leucoloma,* of which, it may be observed, some specimens belong to *Ascobolus Crouani,* Cooke, and of *P. fibrillosa,* Curr., found at Hanham, which resembles externally *P. humosa.*

PLATE III. fig. 15. *a.* ascus with paraphyses, magnified; *b.* sporidia, more highly magnified. The plant from which the dissections were taken was gathered at Hanham.

Fig. 16. *a.* ascus and paraphyses of *P. leucoloma,* magnified; *b.* sporidia, more highly magnified, ·0006–·0008 inch long, ·0004 wide; *c.* end view of ditto.

Fig. 17. *a.* ascus and paraphyses of *P. fibrillosa,* Curr., magnified; *b.* sporidia, more highly magnified, ·0006–·0007 inch long, ·0003 wide.

1157. *P.* (Humaria) *brunneo-atra,* Desm. no. 826.

On the ground. Leigh Wood, C. E. Broome.

Asci linear; sporidia minutely echinulate, ·0007–·0009 inch long. In Desmazière's authentic specimen, ·0006–·00075.

PLATE IV. fig. 18. *a.* ascus, magnified; *b.* sporidia, more highly magnified.

1158. *P.* (Humaria) *salmonicolor,* n. s. Parva, gregaria; cupulis subhemisphæricis hymenioque salmonicoloribus; ascis oblongis; sporidiis biserialibus, ellipticis, enucleatis.

On the side of a ditch. Woodnewton, Oct. 1858.

Sporidia ·0008 inch long, sometimes ·0005 broad. Nearly allied to *P. hæmastigma.*

PLATE IV. fig. 19. *a.* ascus and paraphyses, magnified; *b.* sporidia, more highly magnified.

1159. *P.* (Humaria) *hæmastigma,* Fr. Syst. Myc. ii. p. 74; Sturm, Deutschl. Fl. 33. tab. 11.

On the walls of a cottage. Pen y Gwryd, North Wales, Sept. 1862, C. E. Broome.

Asci short, oblong, subclavate; sporidia biseriate, ·0006 inch long by ·0009, or nearly globose.

PLATE IV. fig. 20. *a.* ascus, magnified; *b.* sporidia, more highly magnified.

1160. *P.* (Encœlium) *fraxinicola,* n. s. Sparsa vel stipata, cupulis extus pallide cervinis furfuraceis, intus fuscis; hymenio leviter depresso; sporidiis uniseriatis.

On ash-twigs. Northamptonshire.

Cups at first closed, then opening with an irregular aperture, at length orbicular, slightly depressed, pale fawn-colour and furfuraceous externally, umber-brown within; hymenium slightly depressed; asci elongated clavate; sporidia uniseriate, elliptic, ·00045 inch long.

PLATE IV. fig. 21. *a.* ascus, magnified; *b.* sporidia, more highly magnified.

**P.* (Sarcoscyphæ) *pygmæa,* Fr. Syst. ii. p. 79.

On bits of dead stick, apparently gorse. Ascot, Rev. G. Sawyer, 1863. In moss and turfy mould, on Blackdown Hills, near Taunton, March 1866. Wimbledon, May 1866.

About $\frac{1}{4}$ inch high when full-grown, stipitate, the stem branching out or dividing into several heads, which form cups resembling the genus *Ditiola* or *Tympanis*; when young and unbranched, resembling *Solenia.* The cups are often proliferous, producing smaller cups on their surface, of a bright apricot-colour, but whitish towards the margin. A figure of the proliferous state will appear in the forthcoming number of the Linnæan

Transactions. Sporidia uniseriate, linear-oblong, ·0005–·0006 inch long.

PLATE IV. fig. 22. *a*. asci, magnified; *b*. sporidia, more highly magnified.

**P*. (Sarcoscyphæ) *radiculata*, Sow. t. 114.

Fine specimens of this rare species have been found this year by Mr. Jerdon near Jedburgh, in a fir-wood.

Sporidia ·0005 inch long, rather broad, binucleate.

PLATE IV. fig. 23. Sporidia, highly magnified.

Fig. 24. *a*. ascus of the same species in Rabenhorst, specimen no. 618; *b*. sporidia of ditto (·0007 inch long), more highly magnified.

1161. *P*. (Sarcoscyphæ) *lanuginosa*, Bull. tab. 396. fig. 2. Var. *Sumneri* cupula demum radiato-fissa, margine junioris anguste nudo.

Under cedars. Fetcham Park, Mrs. Holme Sumner. Chiswick House, Mr. Edmonds, Jan.–May. Under a larch, Wilson Saunders, Esq.

At first entirely buried, then forcing its way through the soil, and splitting into several lobes, like a *Geaster*, which it much resembles from its thick substance. The outer coat is densely clothed with flexuous hairs, very different from those of *Peziza hemisphærica*. The sporidia, moreover, are shortly and bluntly fusiform.

A large and magnificent species, acquiring frequently a diameter of 2 inches, and combining in some measure the characters of *P. sepulta* and *P. hemisphærica*, from both of which it differs materially in the subfusiform fruit. It has also a very close affinity to Tulasne's genus *Hydrocystis*. It has been observed for many years at Fetcham, but has not hitherto been recorded as British. Bulliard's plant is considered by Fries a variety of *P. hemisphærica*, but it is really very different. In plants which are just open a delicate veil is often found stretched over the orifice.

A figure and analysis of this fine fungus will appear in the forthcoming number of the Linnean Transactions.

PLATE IV. fig. 25. *a*. hairs from outer surface, magnified; *b*. ascus with paraphyses, ditto; *c*. sporidia, highly magnified.

1162. *P*. (Sarcoscyphæ) *Geaster*, n. s. Brunnea, cupula subglobosa, floccosa, demum radiato-fissa.

On the ground. Wentworth, Oct. 9, 1858, Mr. J. Henderson.

About an inch across; hairs flexuous, branched, articulated, often giving out little curved hyaline processes with a few straight bristles intermixed. Hymenium brown like the rest of the plant. Paraphyses clavate; sporidia elliptic, with the ends very slightly attenuated, ·0009 inch long. The sporidia of *P. sepulta*, a much coarser species, are of the same length.

This is closely related to the last, but very distinct.

Plate IV. fig. 26. *a.* hairs, magnified; *b.* sporidia, highly magnified. Fig. 27. Sporidia of *P. sepulta,* highly magnified.

1163. *P.* (Sarcoscyphæ) *umbrosa,* Fr. Syst. ii. p. 85.
On the ground. Bewick, Dr. Johnston.
Sporidia ·0008 inch long, ·0007 inch wide.

Plate IV. fig. 28. *a.* hair, magnified; *b.* ascus with paraphyses, ditto; *c.* tips of paraphyses, more highly magnified; *d.* sporidia, ditto.

**P.* (Sarcoscyphæ) *vitellina,* Pers. Myc. Eur. i. p. 257.
On the ground. Wareham, C. E. Broome.
Sporidia ·0009 inch long by ·0005.

Plate IV. fig. 29. *a.* ascus with paraphysis, magnified; *b.* sporidia, more highly magnified.

1164. *P.* (Dasyscyphæ) *calyculæformis,* Schum. Sæl. p. 425.
On dead wood. Twycross, Rev. A. Bloxam, May 10, 1859.
1165. *P.* (Dasyscyphæ) *Acuum,* Fr. Syst. ii. 95.
On leaves of spruce fir. Mossburnford, A. Jerdon, Esq.
1166. *P.* (Fibrina) *leptospora,* n. s. Cupulis primum hemisphæricis, dein applanatis, extus e floccis sparsis nigris minutissimis appressis luridis, intus albidis; sporidiis filiformibus.
On decayed wood. Jedburgh, A. Jerdon, Esq.
About half a line across; at first perfectly globose, often collapsed in the centre, but gradually opening and exposing the soft, pallid, sometimes straw-coloured hymenium. Asci oblong; sporidia very long and slender, filiform, flexuous, with a row of globular nuclei, at length repeatedly septate.

Plate IV. fig. 30. *a.* ascus, magnified; *b.* sporidia, highly magnified.

1167. *P.* (Calycinæ) *imberbis,* Bull. t. 467. f. 2.
On willow. Mossburnford, A. Jerdon, Esq.
Sporidia linear, slightly curved, about ·0004 inch long.
1168. *P.* (Mollisia) *erythrostigma,* n. s. Minima, stipitata, punctiformis, pallide rubra; hymenio demum convexo; ascis clavatis; sporidiis uniseriatis, ellipticis vel subglobosis.
Parasitic on *Sphæria phæostroma.* C. E. Broome.
The stem is mostly curved, distinctly cellular. Asci clavate; spores minute, subglobose. Very minute, but a pretty object under the microscope.

Plate IV. fig. 31. *a.* plant, magnified; *b.* asci with sporidia, highly magnified.

1169. *P.* (Mollisia) *peristomialis,* n. s. Minuta, cylindrica, pallida, ore dentibus longis triangularibus cellulosis albis ornato, disco planiusculo; ascis lanceolatis; sporidiis biserialibus, fusiformibus, multinucleatis.
On holly. Penzance, J. Ralfs, Esq.

A most exquisite object under a moderate magnifier, resembling some Actinia in miniature. Sporidia ·001 inch long.

Plate V. fig. 32. *a.* group, magnified; *b.* ascus, magn.; *c.* sporidia, highly magnified.

1170. *P.* (Mollisia) *viburnicola,* n. s. Subglobosa, dein hemisphærica, cinerea, extus granulata; margine denticulato, furfuraceo; hymenio pallidiore.

On either side of dead leaves of *Viburnum.* Received from England by A. Jerdon, Esq.

Minute, punctiform, externally speckled with little dark tufts of cells, which sometimes give out a few short flexuous hairs. Asci clavate; sporidia lanceolate, ·0004–·0005 inch long.

1171. *P.* (Mollisia) *nervisequia,* Desm. no. 2012.

On leaves of *Plantago lanceolata.* St. Catharines, near Batheaston, Feb. 1852, C. E. Broome.

Sporidia ·0004 inch long.

1172. *Stictis lecanora,* Schm. & Kze. no. 174.

On dead willow-twigs. Jedburgh, A. Jerdon, Esq.

1173. *P.* (Patellea) *Resinæ,* Fr. Syst. vol. ii. p. 149.

On resin. Sparingly near Jedburgh, A. Jerdon, Esq.

This appears to be a true Peziza from its mode of rooting into the bark.

1174. *Helotium pruinosum,* Jerd. in litt. Minutum, candidum, sessile vel brevissime stipitatum totum albo pruinosum; disco pallide carneo; sporidiis elongato-cymbiformibus, 3–4-nucleatis.

On *Hypoxylon fuscum* and *stigma.* Appin, Capt. Carmichael. Jedburgh, A. Jerdon, Esq.

The hymenium, which has sometimes a slight blush tinge, is pruinose as well as the outer surface. Sporidia ·0006 inch long. Some of the specimens referred formerly to *Peziza episphæria* certainly belong to this species, which was originally called *P. pruinosa* by Capt. Carmichael. The same plant occurs at Belvoir, with the sporidia ·0004–·0005 inch long.

Plate V. fig. 33. Sporidia, highly magnified.

1175. *Hypomyces Broomeianus,* Tul. Carp. iii. p. 108 (*Hypocrea luteo-virens,* Rabenh. no. 751).

On *Polyporus annosus.* Batheaston, C. E. Broome.

Plate V. fig. 34. *a.* thread with conidia, magnified; *b.* conidia, ·0002–·0003 inch long, more highly magnified; *c.* ascus, magn.; *d.* sporidia, ·0005–·0006 inch long, highly magnified.

**H. ochraceus,* Tul. Carp. iii. p. 41.

This is, in all probability, *Cryptomyces aurantia,* Grev. t. 78. *Blastotrichum Puccinioides,* Preuss, Sturm's Deutschl. Fl. 25 & 26, tab. 11, is evidently a state of this or some closely allied species, and has occurred at Batheaston. *Hypomyces aurantius* has been

found in Flintshire, on *Pol. squamosus,* and has also been gathered on *Agaricus ostreatus. Sphæria aurea,* Grev., is a *Nectria.* The species from Laxton on *Boletus* is *H. luteo-virens.*

PLATE V. fig. 35. *a.* ascus, magnified; *b.* sporidia, ·001 inch long, highly magnified.

1176. *Hypocrea delicatula,* Tul. Ann. d. Sc. Nat. sér. 4. vol. xiii. p. 18; Carp. Fasc. iii. tab. 4. figs. 7–13.

Fir-plantations. Lucknam, April 1866.

This extremely interesting fungus is nearly allied to *H. citrina,* of which it has the habit. It forms patches which are easily separable from the matrix, of a delicate cream-colour, studded with the fawn-coloured perithecia.

1177. *Sphæria* (Denudatæ) *Epochnii,* n. s. Peritheciis primum conicis, dein subglobosis, collapsis, stipatis, atro-olivaceis, granulatis; ascis clavatis; sporidiis uniserialibus, fusiformibus, medio constrictis, demum triseptatis; conidiis elongatis, triseptatis, apice incrassatis.

On *Epochnium fungorum,* of which it is the perfect form. Warleigh, near Bath, March 1866.

Perithecia at first pale bottle-green, crowded in the centre of the *Epochnium,* then black green, granulated, sometimes depressed at the summit, with a minute pore. Asci clavate, containing a single row of triseptate fusiform sporidia, ·001–·0011 long, strongly constricted in the centre, at length pale brown, when they resemble a good deal the naked spores of the *Epochnium.* The sporidia are at first uniseptate, with two nuclei in each division.

PLATE V. fig. 36. *a.* plant, magnified; *b.* portion of mycelium with conidia (epochnium); *c.* conidia, highly magn.; *d.* ascus with sporidia, magn.; *e.* sporidia, young and old, highly magnified.

1178. *S.* (Caulicolæ) *Alliariæ,* Auersw. Rab. no. 261.

On *Erysimum Alliaria.* Jedburgh, A. Jerdon, Esq.

1179. *Dothidea melanops,* Tul. Carp. ii. p. 73, tab. 10.

Abundant on beech near Jedburgh, but without perithecia. A. Jerdon, Esq.

Mr. Jerdon's specimens, though on beech, correspond better with Tulasne's typical form on oak than his variety *fagicola.* The stylospores are just the same, and not comparatively short, as in the variety.

1180. *Hysterium varium,* Fr. Syst. vol. ii. p. 582; Duby, Hyst. p. 28.

On decorticated branches of yew. Wynd Cliff, April 18, 1866.

Scattered over pallid spots; perithecia elliptic, subimmersed, with a slight keel and very obscure aperture, quite even; asci elongated; sporidia uniseriate, elliptic, slightly pointed at either

end, uniseptate, with a large nucleus in each division, ·001 inch long by ·0005 broad.

The sporidia of this and the next species differ entirely from those of our other British species. Duby's plant is on *Juniperus phœniceus*, that of Fries on oak.

Plate V. fig. 37. *a.* asci and paraphyses; *b.* sporidia, highly magnified.

1181. *H. repandum*, Blox., Duby, Hyst. p. 27, tab. 1. f. 6.

On rotten stumps. Orton Wood, near Twycross, Rev. A. Bloxam.

Perithecia almost free, elliptic, the lips well rounded; aperture gaping. Asci rather short; sporidia broadly cymbiform, the apex at one end very slightly elongated and perfectly hyaline, ·0006–·0007 inch long*.

Plate V. fig. 38. *a.* ascus and paraphyses, magnified; *b.* sporidia, more highly magnified.

BIBLIOGRAPHICAL NOTICE.

Geological Map of England and Wales. By Prof. Ramsay, F.R.S., F.G.S., &c. 3rd edition. 1866.

That a new edition of this useful Map should be required speaks well of the public taste for geological knowledge; or at all events indicates that the public find that they require and can use a map showing at a glance to those who can read it aright the real structure of the country, the chief characters of its hills and valleys, the courses of its rivers in relation to the nature of the uplands, and the projections and hollows of its coasts in relation to the harder and softer materials of its rocky skeleton, and, still more, the relative position of its mines, coal-pits, quarries, and other sources of mineral wealth. The traveller may, if he will, recognize the geological character of the country he is passing through by rail or otherwise, by referring to this handy sheet; the tourist may spread it out on the green sward, the beach, or the barren hill-top, and trace out the deep-set roots of the mountain, the inland range of the sea-cut strata, or the structure of hill and dale around, and take in new pleasure with his satisfied curiosity, besides all the delight that light and shade, form and colour, changing cloud and rippling water can give him, be he artist or amateur. Fishing and shooting, too, have an additional zest with the geologist; for he is rarely too busy not to see something new; and when sport is dull, the eye is still pleasingly at work.

* *Coniocybe bæomyciodes*, Erbario Crittogamico Italiano.
On turpentine. Lucknam, Dec. 10, 1864.
From pallid white to a bright yellow, sometimes brick-red, scattered over some *Sporidesmium* (*Tromera resinæ*) which colours the turpentine black.
The genus *Coniocybe* is a very doubtful member of the Fungi; and the species, which is new to Great Britain, is therefore recorded in a note.

After a day's hunting a geological map has explained why white mud and brown, black clay and white chalk, peat-bog and sand-hills have succeeded each other so quickly in the run across country,—or why one long gallop carried along with it the uniform splashing of yellow mud with little change. Of course, now-a-days, geological maps are hanging up in halls and studies far more frequently than in times past; and instead of trying to find causes for differences of peoples and lands in county-boundaries and political divisions, we look to mountains and valleys, hills and dales, with their varying geological structures, as land-marks among men, whether in counties, provinces, or continents. The traveller in unknown lands brings home but a meagre account of the geography of the country he would describe if he knows not its real structure: he may make a model even of its heights and rivers; but, without a knowledge of its strata, his model will fall as short in actual worth as a badly painted portrait. Not only will a full appreciation of structural peculiarities of hill and cliff be wanting, but none of the links of analogy or identity that bind it on to the strata of other lands can be indicated; and, like the nameless ruined column, it waits for further elucidation.

At home our geological maps are progressing rapidly towards perfection. Amateur workers have accumulated observations for more than fifty years; and within about twenty years a systematic plan of geologizing the British Isles has been carried on by the State. The Government Geologists, well trained, enthusiastic, and yet cautious, fairly using the results of fore-gotten knowledge, have worked as quickly as their limited numbers would permit. Thus they have gone over Wales, the South of England, much of the Midland Counties, some parts further north in Scotland, and a large part of Ireland. From these results Prof. Ramsay has carefully produced the Map of England and Wales before us, filling up unsurveyed areas with the results of amateur and casual work. In this third edition we may easily see where earlier mapping has given way to the work of adepts and professional geologists, working over every inch of the ground, going along the whole line of an outcrop, trusting nothing to fancy or the memory, but examining and noting with precision, day by day. In this way the broad areas of colour, with boldly rounded and entire boundary-lines, filled in as the result of a holiday's research or rapid sketch-work, must be replaced by the laborious entanglement of outlier, inlier, and jagged border of outcrops along broken ground, carrying at once an appearance of truth to the experienced eye. Thus in the so-called "London Basin" more detail in the northern border of the Tertiary beds is now given; and the Bagshot formation and the alluvium of the Thames are far more correctly delineated. The Tertiary outliers at the west of this area, and those between it and the "Hants basin," are altogether rearranged, patches of "Drift" apparently having formerly been mistaken in many instances. The Wealden area is now far better characterized in accordance with the late researches of the Geological Surveyors, who have worked out its complicated structure as carefully as if it were a coal-field; nor indeed do we know but what it

will be soon necessary to apply their knowledge in the search for coal in the old ridge of crumpled palæozoic rocks beneath its northern border.

The West of England has received a few touches here and there; but the outcrops of the Cretaceous and Upper Oolite beds through Berks, Bucks, and Cambridgeshire have been carefully revised; and so have the Oolites of Northamptonshire and Oxfordshire. Still more important is the improved work in the Warwickshire and Leicestershire Coal-fields, and in Charnwood Forest, with its Cambrian (if not older) rocks. The North-Staffordshire and Lancashire Coal-fields become, as it were, remodelled by the now accurate outlines of their areas; and the neighbourhood of Manchester, in particular, passes from an artificial to a natural appearance, geologically viewed. The great Permian range, from Durham southward, is taking its natural form on paper; for the Survey has reached northwards much beyond Doncaster. The red sandstones of the Eden and of the west coast of Cumberland now appear in their true Permian colours; and various spots in Northumbria also speak of the researches of several active geologists of to-day. Lastly, in Wales a few modifications of outlines in the Old Red and the complicated patches of igneous rocks may be noticed. The illustrated sections are repeated (with stronger lettering) on the margins, as heretofore.

In this new map there are additions to the railways, bolder distinctive numbers to the different formations, and modifications in some of the tints; and an important mass of information is added in notes and remarks all around the coast.

The general result is that we have a very useful and handsome Geological Map of England and Wales (12 miles to the inch), not so large as the "Greenough Map" published by the Geological Society of London, but constructed on the same basis, and containing a very large amount of useful information, clearly put by the master-hand of an accomplished geologist, and produced in good style by an intelligent publisher.

PROCEEDINGS OF LEARNED SOCIETIES.

ROYAL SOCIETY.

April 26, 1866.—J. P. Gassiott, Vice-President, in the Chair.

"On the Dentition of *Rhinoceros leptorhinus* (Owen)." By W. Boyd Dawkins, M.A., Oxon., F.G.S.

The fossil remains of the genus *Rhinoceros* found in Pleistocene deposits in Great Britain indicate four well-defined species. Of these the *R. tichorhinus*, or the common fossil species, ranged throughout France, Germany, and Northern Russia, and, like its congener the Mammoth, was defended from the intense winter cold by a thick clothing of hair and wool. Its southern limit in the Europæo-Asiatic continent was a line passing through the Pyrenees, the Alps, the northern shore of the Caspian, and the Altai Mountains.

It has not yet been proved to have existed in Europe anterior to the deposit of the Boulder Clay. The second species, the *R. megarhinus* of M. de Christol, characterized by its slender limbs and the absence of the "cloison," has been determined by the author among remains from the brick-earths occupying the lower part of the Thames valley, and from the Preglacial forest-bed of Cromer. The species ranged from the Norfolk shore southwards through Central France into Italy. In France and Italy it characterizes the Pliocene deposits, being found in the former country in association with *Mastodon brevirostris* and *Halitherium Serresii*, in the latter with *M. Arvernensis*. From its southern range we may infer that the megarhine species was fitted to inhabit the warm and temperate zones of Europe, just as the tichorhine was peculiarly fitted for the endurance of an Arctic winter.

The third species is the *R. etruscus* of Dr. Falconer, confined to the forest-bed of the Norfolk shore, and, like the *R. megarhinus*, found in the Pliocenes of France and Italy; it ranged across the Pyrenees as far as Malaga, and is the only species known to occur in Spain.

The fourth, the *R. leptorhinus* of Professor Owen, is the equivalent of the *R. hemitœchus* of Dr. Falconer. It is defined as "R. à narines demicloisonnées," and is probably not the same animal as the *R. leptorhinus* or "*R. à narines non-cloisonnées*" of Baron Cuvier, the evidence as to the absence or presence of the cloison in the type of the species being of the most conflicting nature. In Central France it is identical with *R. mesotropus* and *R. velaunus* of M. Aymard, the *R. Aymardi* of M. Pomel, and the *R. leptorhinus* (du Puy) of M. Gervais. Its dentition is characterized by the presence of the *third costa* in the upper molar series, coupled with the stoutness of the cingulum, the suppression of the *anterior combing plate*, the smoothness of the enamel, and the extent to which the upper molars overhang the lower, which causes the enamel on the outer side of the latter to be worn obliquely. The lower molars can be determined by the flattening of the *anterior area*, coupled with the fine sculpturing of the enamel-surface. In common with the other fossil British Rhinoceroses, it possessed a molar series of six only on either side, and was bicorn. It ranged through England, from the Hyæna-den of Kirkdale in Yorkshire in the north, as far south as the plains of Somersetshire, and as far to the West as Pembrokeshire. It is very generally found in association with *Elephas antiquus* and *Hippopotamus major*, both species which lived in Pliocene times. The association in Wookey Hole Hyæna-den with *Elephas primigenius* and *R. tichorhinus* and other characteristic Postglacial mammals proves that it coexisted with the tichorhine species, to which it probably bore the same geographical relation as the Elk does to the Reindeer in the high northern latitudes. The sum of the evidence proves that it was coeval with the Mammoth and tichorhine Rhinoceros, and does not characterize deposits of an earlier epoch in the Pleistocene. It has not as yet been found in Preglacial formations. The *R. leptorhinus* is more closely allied to the bicorn Rhinoceros of Sumatra than to any other living species.

MISCELLANEOUS.

On the Morphology and Affinities of the Brachiopoda. By H. Lacaze-Duthiers.

Few animals are so widely diffused in the strata of the surface of the globe as the Brachiopoda, and few consequently are so frequently in the hands of naturalists; nevertheless, although they are represented by many species living in our seas, their zoological relations and their general plan of organization are by no means agreed upon.

Placed in the first instance among the Acephala, side by side with the Lamellibranchiata, they now justly form a distinct division; but the relationships of this division are far from being the same in the eyes of all zoologists. Thus, to dwell only upon the last opinion, Messrs. Huxley and Hancock, two of the most eminent English naturalists, would place them among the Molluscoida, by the side of the Ascidia and Bryozoa or Polyzoa.

This new mode of appreciating the affinities of this group led me to desire to study these creatures afresh; and when the opportunity was afforded me of investigating the faunas of great depths in the Meditterranean, I hastened to resume observations commenced about 1858 in the sea off Corsica.

To determine the affinities of the Brachiopoda I seek in their nervous system for the criterion that must guide me. It is to the characteristic organ of animality that I apply myself, because, as has been so admirably shown by Cuvier, it furnishes the characters of highest value; and I compare it on the one hand to that of the Lamellibranchiata, and on the other to that of the Bryozoa.

In the Lamellibranchiate Acephalan the plan of organization is simple. The organs are repeated symmetrically on each side of the median line. Thus we find three double nervous centres—one near the mouth, another in the foot, the third between the base of the foot and the anus, near the branchiæ. Moreover certain organs have an existence, a peculiar symmetry, and very precise relations with these different centres.

Upon the median line are the mouth, the foot, and the anus. At the base of the foot, between it and the anus, on each side, beyond the ganglia of the third or pallio-branchial group, open the two glandular bodies called the glands of Bojanus; lastly, to the right and left of the mouth there are two pairs of labial *vela*, which vary greatly in form in the different species.

To compare this well-known plan, which it was necessary to refer to here, with that of the Brachiopods, we must first of all place the animals in a comparable position. Suppose, for example, that we have a *Terebratula* and an *Anodonta* to compare: the former must be placed with its ligament downwards, its apophysary valve to the left of the observer, and its perforated valve to his right; the second must have its hinge to the left and its mouth upwards. Most figures show the Brachiopoda in a position the reverse of that just indicated, which renders their comparison with the Acephala more difficult.

In the animals thus placed the first difference that presents itself, and that which has most caught the attention of observers, is this: the *Anodonta* has its valves lateral; the *Terebratula* has one of them dorsal, the other abdominal.

This difference, which appears very great, has not quite so much importance as we should be inclined to attribute to it at first sight; we need only free it from the secondary conditions which surround it, so as to see only the fundamental parts. Thus the greatly developed and multiplied muscles have become longitudinal and symmetrical, in consequence of the arrangement of the valves, and they have attracted the attention of naturalists perhaps too specially, and led them to neglect other more important organs.

As the Brachiopod lives attached, a special locomotive organ would be useless to it; therefore its foot is aborted, and with it the corresponding portion of the nervous system. Here, morphologically speaking, we have a great and fundamental difference, very different from that presented by the position of the valves.

On each side of the mouth of the Terebratula we find two long fringed arms, rolled up in a spiral form, and accompanied by a membranous lip; these are the analogues of the labial vela of the Lamellibranchiata. The investigation of the nervous system justifies this notion; for there exist two small symmetrical ganglia which, with the assistance of the long commissure uniting them, surround the œsophagus like a collar, and furnish nerves to the arms, as in the Lamellibranchiata the analogous ganglia furnish the nerves to the labial vela.

These first ganglia, which are difficult to discover, correspond with the œsophageal ganglia of the other Mollusca; they are united by long connectives with the most highly developed and therefore most evident nervous masses, which are found above the mouth, in the median line, in the fold of the two lobes of the mantle. We know that this last organ performs, in great part, the function of the organ of respiration; and as it receives its nerves from this last ganglionic centre, this may be regarded as the analogue of the pallio-branchial centre.

As to the pedal ganglia, they do not exist, as the organ for which they are necessary is wanting.

The organs of Bojanus and those of reproduction open in the *Terebratula,* as in the *Anodonta,* symmetrically outside and by the side of the pallio-branchial nervous centre. Moreover, according to the beautiful investigations of Mr. Hancock, the heart in the Brachiopoda is dorsal, which furnishes an additional feature of resemblance between the two groups, for in this way the central organ of the circulation is separated from the organs of Bojanus and the pallio-branchial ganglia by the digestive tube.

Lastly, in the Brachiopod, as in the Lamellibranchiate Acephalan, the organs just referred to are repeated symmetrically on each side of the median line of the body.

Thus if we suppress in the Lamellibranchiate Acephalan the foot and the pedal ganglia, there remains an organism having the greatest

analogy with that of the Brachiopod, always excepting the position of the valves. Now this is also easy to be brought under the general plan of the *Anodonta*, if we suppose the two lateral lobes of the mantle to be united above the mouth and below the anus, and imagine that about the middle of its length an emargination is formed which may advance as far as the hinge; for then the two halves of the mantle are no longer lateral, but dorsal and abdominal, and the shell reproduces the pattern upon which it models itself.

The modifications undergone by the muscles are the consequences of the changes of arrangement which have taken place in the shell; they cannot invalidate the zoological approximation which I am endeavouring to establish. Do we not, for example, find an Ascidian (*Chevreulius*) presenting symmetrical muscles analogous to those of the Terebratulæ, and this merely because its tunic has become bivalve, and without one being able to remove it from the group to which it belongs?

If we now compare the Polyzoan or Bryozoan with the Brachiopod, we find some external resemblances, but profound differences of greater importance. No doubt the Bryozoan often presents an organ in the form of a horseshoe, placed close to the mouth, and which may be compared to the arms of the Brachiopods; but this is not a sufficient feature of resemblance to bring together animals so different. If we look at the nervous system, we shall soon be convinced.

Hitherto the Molluscoida have presented only a very simple nervous ganglion, without an œsophageal collar, and without any very evident double symmetry; consequently they are more distant from the Brachiopoda than the latter from the Lamellibranchiata.

Thus the investigation of the nervous system legitimates the approximation which we are seeking to establish, and does not justify that which the English authors have attempted; but it leads us also to recognize the necessity of making a distinct group for the Brachiopods, which are much rather degraded Acephala than elevated Molluscoida.

These zoological relationships are by no means invalidated by an organic peculiarity as curious as unexpected. Professor Huxley was the first to demonstrate the non-perforation of the anal extremity of the intestine in the Terebratulæ, and I have myself confirmed this observation in several other genera and species; this arrangement forms a very remarkable exception among the Mollusca, and appears to be especially proper to the Articulate Brachiopods, which really represent *Cœlenterate Mollusca*.

The preceding general observations constitute a *résumé* of minute and detailed investigations undertaken in 1858 in Corsica, and in 1862 in Algeria, upon the genera *Megerlia*, *Terebratulina*, *Thecidia*, *Argiope*, and *Crania*, which inhabit the Mediterranean, and were all observed living on the spots which they inhabit.—*Comptes Rendus*, November 6, 1865, pp. 800–803.

On the finding of a second Ribbonfish.

To the Editors of the Annals and Magazine of Natural History.

Gentlemen,—Having heard in May last that another Ribbonfish, or *Gymnetrus*, had been found near Whitby, and being in that town on Monday last, I inquired for it in the museum, and I was shown the specimen by an assistant there.

This fish is labelled "Ribbond fish cast up at Whitby, April 23, 1866," but its specific name is not given. It was cast upon the sands near Whitby, and was discovered by some schoolboys. Being unwieldy, and 10 feet long, they could not convey it with them; so they cleverly cut it into five slices, and then carried the slices separately. A man who stuffs birds near the museum has preserved it very well, and sewn together the five slices. The tail is broken; there are no appendages about the head; and the long dorsal fin is a good deal injured, as well as the numerous rays. From want of time, and the glass case being so close to the back of the fish, I could not wait to count the number of the rays. This specimen may be, like that cast up at Seaton Snook on the 1st or 2nd of last March, the *Gymnetrus Banksii*, which was 14 feet 7 inches in length; though I am inclined to think it is the "king of the herrings," as one of the species is called.

The distance from Seaton Snook to Whitby Sands is some thirty miles along the Yorkshire coast, to the south-east.

I am, Gentlemen,
Yours truly,
John Hogg.

Norton House, Stockton-on-Tees,
July 6, 1866.

A few words on the Mammoth, in connexion with the Engravings recently found in Périgord and supposed to represent this Animal.* By H. Brandt.

Professor Brandt, referring to the account given by M. Lartet of a plate of fossil ivory from Périgord bearing incisions which appeared to represent an elephant with a long mane, and to a second note by M. Vibraye on the reproduction in reindeer-horn of a head supposed to be that of the Mammoth, remarks that these discoveries were particularly interesting to him, as he had been for years accumulating materials towards a monograph of the Mammoth. He states that as long as ten years ago, in his memoir on the distribution of the Tiger, he expressed the opinion that *Elephas primigenius, Rhinoceros tichorhinus, Cervus euryceros, Bos primigenius, Bos urus, Bos moschatus, Cervus Alces, Elaphus,* and *Tarandus,* &c., belonged, with man, to a single contemporary fauna, that in Asia these large animals were pursued by the tiger at the most distant periods, and that the remainder was in part destroyed by man.

* According to a note appended by Milne-Edwards to the title of this paper, the proper spelling of the name of this animal is "Mamont."

The researches made in France have shown the truth of this opinion; but Professor Brandt makes the following observations on the figures of the Mammoth described by MM. Lartet and Vibraye. The figure on a plate of ivory described by the former evidently represents the anterior half of an elephant; and it is quite clear that, by means of the lines observed on the neck, shoulders, and flank, the artist has tried to indicate long hairs, which might be regarded as representing parts of a mane. The direction of the tusks reminds one vividly of the Mammoth; but it must be remarked, with regard to the mane, that neither the form nor the density of this has yet been sufficiently demonstrated by naturalists. Adams accepted the notion of a mane, without having seen it, from the testimony of his companions and the presence of long hairs; and Tilesius does not oppose this conclusion. But the merchant Boltunoff, who saw the Mammoth three years before the arrival of Adams, and in a much better state of preservation, says nothing about a mane. Nevertheless two pieces of the skin of the nape, still attached to the cranium of the Mammoth at St. Petersburg, show a considerable quantity of the basal portions of rigid hairs, which were evidently rather long, and may at least be taken for traces of the existence of a mane. Perhaps, however, the artist of Périgord had a better opportunity of recognizing the mane than the Russian naturalists.

The representation of an elephant in reindeer's horn, described by M. Vibraye, seems to resemble the Indian elephant, at least as regards the anterior part of the head. The ear is rather close to the eye; it is oblong and comparatively very narrow. All these characters, especially the small size of the ear, remind us of the Mammoth. —*Ann. des Sc. Nat.* sér. 5. tome v. pp. 280–282.

Note on the Discovery of the Dermal Shield in Megatheroid Animals. By Prof. Reinhardt.

To the Editors of the Annals and Magazine of Natural History.

Gentlemen,—I send you for insertion in the 'Annals' an extract from a letter received from Professor Reinhardt, of Copenhagen, and remain

Yours obediently,

British Museum, A. Günther.

July 23, 1866.

"May I also draw your attention to the fact that this 'discovery' of a dermal shield in Megatheroid animals was made as much as twenty years ago, and that Lund, in his last work on the extinct Mammalian Fauna of Brazil, expressly states that he found a kind of dermal shield in two different genera, *Scelidotherium* and *Cœlodon*, gives a very detailed description of them, and even draws the at that time justifiable and natural conclusion that probably all Megatheroid animals were furnished with a more or less similar shield. The shield was not so *perfectly* developed in *Scelidotherium* and *Cœlodon* as Burmeister has found it to be in *Mylodon*; but that is of small importance (see 'Det Kongelige Danske Videnskabernes Selskabs Afhandlinger,' Kjöbenhavn, 1846, 12 Deel, p. 77)."

On the Structure of the Anthers in the Aroideæ. By M. van Tieghem.

From his investigations Chatin has deduced the general rule, that *anthers which open by terminal pores are destitute of fibrous cells.* The genus *Solanum,* the anthers of which have fibrous cells round the terminal pore, forms a curious exception to this. The author indicates the occurrence of similar exceptions in the apicilar anthers of several *Aroideæ.*

The sessile anther of *Richardia africana,* Schott, has two loculi, each divided into two locelli by a delicate longitudinal septum; and these open at the apex by a small vertical tube pierced through the thick plate formed by the connective above the loculi; beneath this terminal pore the septum is absorbed, to enable the loculi to communicate. The inner wall of the chamber is clothed, when mature, with a layer of prismatic cells perpendicular to its surface, and furnished with strong spiral bands. In each locellus this layer of spiral cells ceases at the two lines of origin of the septum, where it curves inwards a little and unites by means of smaller cells with the corresponding layer of the neighbouring locellus, thus forming two longitudinal ridges. The septum is therefore destitute of fibrous cells; when mature, it is composed only of a layer of interlaced threads, the remains of the cells of which it was originally composed. The delicate cellular membrane which clothes the whole interior of the locelli in the young anther is absorbed at the moment of dehiscence. The layer of spiral cells is continued to the terminal pore, the inner orifice of which it borders; but it does not line the wall of the little tube, which is formed of colourless cells, each containing a grain of starch, whilst the cells of the plate are larger and filled with a yellow liquid. Here, therefore, we have exactly the reverse of what occurs in *Solanum,* where the fibrous cells surround the pore without extending upon the inner surface of the cell.

The mode in which the anther of *Richardia* emits its pollen shows that it is a powerful agent of expulsion. Through each pore a white thread is seen to issue and become longer by degrees, which at last forms a little cotton-like ball, of a dull white colour, round the orifice. This filament is composed of two or three parallel rows of ovoid pollen-grains united by a gummy liquid; by exposure to the air, this cement evaporates, and the grains, becoming free, are disseminated. The author considers that the contraction of the cell causing this expulsion of the pollen is produced by the layer of fibrous cells; but he is unable to explain its mode of action.

In the anther of *Alocasia odora* and *metallica,* Schott, each of the two cells arranged round the dilated connective is constructed nearly in the same manner; but the cell, instead of opening upon the plate itself by a duct traversing its thickness, is bent outwards and opens directly beneath the plate by an orifice common to two confluent cells; the fibrous cells predominate round the pore, and several other rows are frequently added to the ordinary one at the upper part of the curve.

The difference is greater in *Aglaonema marantæfolia*, Schott. The bilocular anther is furnished with a short filament, and the connective does not form a plate. Each cell is divided into two locelli by a thick septum, absorbed beneath the terminal pore where the locelli communicate. The inner wall of each locellus is lined throughout with a strong layer of perpendicular fibrous cells: hence the quadrilocular structure of the anther. The fibrous layer is produced upon the outer walls up to the orifice, where it is covered directly by the epidermis.

Hence there is no necessary correlation between apicilar dehiscence and the absence of fibrous cells. The presence or absence of these is a character of more constancy and of a higher order than the mode of dehiscence. Thus in the Aroideæ we pass by insensible gradations from *Richardia*, &c., in which the apicilar dehiscence is most strongly marked, through *Arum* and *Dracunculus*, to rimate dehiscence, either transverse (*Arisarum*) or longitudinal (*Calla*, *Anthurium*, &c.), whilst the fibrous layer is still strongly developed; and this is further seen from the complete absence of these cells in *Lycopersicum* (where the dehiscence is longitudinal), and their nearly complete absence in *Solanum* (where it is apicilar). Moreover apicilar dehiscence is by no means common to all the genera of the families in which M. Chatin has ascertained the general absence of the fibrous cells: thus the Epacrideæ open their unilocular anthers by a longitudinal fissure; among the Ericaceæ *Leiophyllum*, *Pieris*, and *Epigæa*, and among the Melastomaceæ *Mouriria*, *Memecylon*, &c., open their bilocular anthers by two longitudinal fissures; lastly, in the Monotropeæ the unilocular anthers of *Monotropa* and *Hypopitys* open by a transverse fissure, whilst the bilocular anthers of *Pterospora* have a longitudinal dehiscence; and yet the fibrous layer is wanting in all these genera.

M. Chatin has also observed the structure of some abnormal anthers (those of *Hypoxis erecta* and *Pittosporum Tobira*), "which are destitute of fibrous cells at the same time that they are empty of pollen, or only contain it in an imperfect state; these sterile anthers have, no doubt, been seized by an arrest of development acting simultaneously upon the tissues of the second membrane and upon the pollen;" and from this he concludes "that in some plants the stamens of which have undergone an arrest of development, the absence of fibrous cells coincides with the imperfect evolution of the pollen." The author's observations upon *Ranunculus Ficaria* show that something very different may be the case. The anthers of the bulbiferous variety of this species produce no pollen, and this is the sole cause of the sterility of the plant. Each anther-cell, divided into two locelli by a septum, has its valve formed of an epidermis thickened by a layer of spiral and reticulated cells which does not extend over the septum or upon the inner wall of the cell formed by the connective, as appears to be generally the case in the *Ranunculi*. In the interior of each locellus there is a long mass narrowed at the two extremities, formed of several rows of large, polyhedric, colourless, thick-walled cells furnished with numerous dots; these cells

are united into a continuous tissue, separate from the walls of the locellus, so that these four masses may easily be extracted from the anthers. The mother cells of the pollen, instead of giving origin to ordinary grains and then becoming absorbed, have become thickened and acquired dotted walls. The layer of fibrous cells, however, has acquired its normal structure, although the author has never seen the anthers open, which would seem to indicate that the pollen-grains themselves have a part to perform in producing dehiscence. Hence two conclusions may be drawn:—

1. The abortion of the pollen in the anther does not always, as in the two examples cited by M. Chatin, imply that of the fibrous cells; the arrest of development may affect the mother cells of the pollen without reaching the walls of the anther.

2. Of the two simultaneous functions assigned by M. Chatin to the transitory membrane of the anther, which, according to him, is at once "the nurse of the pollen" and "the reservoir from which the cells of the second membrane draw the nourishment necessary for their rapid transformation," the latter alone is confirmed by the above observations.—*Comptes Rendus,* June 11, 1866, pp. 1289–1294.

Habits of Zosterops dorsalis. By the Rev. R. Taylor.

(*In a Letter to Dr. J. E. Gray.*)

My dear Sir,—I have received your letter acknowledging mine with the *Zosterops dorsalis*; and I am pleased to find that I am correct in my supposition of its being an arrival from Australia or Tasmania. It appears to increase in New Zealand in a most extraordinary way, far more rapidly than any of our indigenous birds, and flies about in large flocks of several hundreds, making an incessant chattering,—quite a novelty in that respect. We hailed it as a blessing on its first arrival, as it attacked the American blight-insect and cleared the trees of it; but we now find it is of doubtful good, for it feeds upon the tender buds of the tree as well; and as at the approach of summer it retires to the high grounds of the interior, it gives the blight time to become as bad as ever before it returns.

Several new discoveries have been lately made in ornithology in the middle isle; but I think some of the birds supposed to be newly discovered are in reality old acquaintances. I expected to find the *Nestor superbus* to be quite new; but when I saw a specimen of it at the Otago Exhibition last year, I found it was my old friend figured in my work as the Korako (*Nestor meridionalis*); and lately a far more beautiful specimen of the same bird was procured by Mr. Buller, which was taken up the Wanganni river, with a brilliant bright-red back as well as breast. It is probably the male Korako.

Believe me, my dear Sir,

Ever most sincerely yours,

Richard Taylor.

Wanganni, May 7, 1866.

On the Organic Bodies contained in Ancient Egyptian Bricks. By Professor UNGER.

The author lately obtained some tiles from the well-known brick pyramid of Dashur, the building of which dates between 3300 and 3400 years B.C. These, like all the Egyptian bricks, have been made with an addition of desert sand and chopped straw, in order to give them greater cohesion and durability. Both with the principal mass, the Nile-mud, and the chopped straw, seeds of various plants, animal remains, and artificial products were accidentally introduced into the manufacture; so that, the consistency of the enclosing substance having remained unaltered, these bodies have also been preserved unchanged to the present time, and are therefore to be recognized quite distinctly.

The investigation of these bodies, which are generally small, showed the presence, at the remote period of the building of the pyramid, of five different cultivated plants, seven field-weeds, and some local plants, together with several freshwater Mollusca and remains of fishes and insects, &c., but all organisms which still for the most part occur in Egypt, and have hitherto remained unaltered.

Besides two cereals (wheat and barley), there were found the teff (*Eragrostis habyssinica*), the field-pea (*Pisum arvense*), and the flax (*Linum usitatissimum*); the last was, in all probability, employed both as a food-plant and for textile purposes.

Greater interest attaches to the weeds, which belong to the commonest kinds, and have necessarily migrated with the cultivated plants, not only over all Europe, but over the greater part of the earth. Among them may be named *Rhaphanus Rhaphanistrum*, *Chrysanthemum segetum*, *Euphorbia helioscopia*, *Chenopodium murale*, *Bupleurum aristatum*, and *Vicia sativa*.

Of artificial products, there were found fragments of burnt bricks and earthen vessels, a small piece of linen thread and one of woollen thread—all of which indicate a tolerably advanced civilization at the time of the building of this pyramid. Moreover the condition in which all these enclosed objects, especially the chopped straw, occurred, proves that brick-making was really carried on in the manner stated by Herodotus and described in Exodus v. 11.

The author expresses a hope that a continued investigation of this material will furnish much important information as to the commencement of civilization in Egypt, and that the dumb and sealed-up bricks of Nile-mud will tell us many things that we seek in vain in the old buildings and sarcophagi, to say nothing of written records. —*Anzeigen der Akad. der Wiss. in Wien, math-naturw. Classe*, June 14, 1866, pp. 141, 142.

Interchange of Birds between America and Europe.

In a memoir presented by Mr. Spencer F. Baird to the National Academy of Sciences, "On the Distribution and Migrations of North American Birds," an abstract of which is published in Silliman's Journal for January, March, and May of this year, the author de-

duces the following generalizations in regard to the interchange of birds between America and Europe.

European birds, especially the land species, reach Greenland and return to the continent by way of Iceland, the Faroe Islands forming a stepping-stone from Great Britain and Scandinavia. In very rare instances species seem to proceed direct to Greenland, without stopping in Iceland, although this may be due to the fact that while visiting Iceland they have not yet been noted there by any naturalist.

The European birds found on the continent of North America reach it by autumnal movement from Greenland in company with strictly North American species.

Birds of North America rarely, if ever, reach England from Greenland by direct spontaneous migration by way of Iceland, as shown by the fact that only three of the American birds occurring in Greenland are found in Iceland, and that few of the American species observed in Europe are found in Greenland at all.

Most specimens of American birds recorded as found in Europe were taken in England (about fifty out of sixty-nine), some of them in Heligoland; very few on the continent (land birds in only five instances).

In nearly all cases these specimens belonged to species abundant during summer in New England and the eastern provinces of British America.

In a great majority of cases the occurrence of American birds in England, Heligoland, and the Bermudas has been in the autumnal months.

The clue to these peculiarities attending the interchange of species of the two continents will be found in the study of the laws of the winds of the northern hemisphere, as developed by Prof. Henry and Prof. Coffin. These gentlemen have shown (see Prof. Henry's articles on Meteorology, 'Report of Commissioner of Patents for 1856,' p. 489) that the "resultant motion of the surface atmosphere, between latitudes 32° and 58° in North America, is from the west, the belt being twenty degrees wide, and its greatest intensity in the latitude of 45°. This, however, must oscillate north and south, at different seasons of the year, with the varying declination of the sun. South of this belt, in Georgia, Louisiana, &c., the country is influenced, at certain seasons of the year, by the north-east trade-winds, and north of the same belt by the polar winds, which, on account of the rotation of the earth, tend to take a direction towards the west. It must be recollected that the westerly direction of the belt here spoken of is principally the resultant of the south-westerly and north-westerly winds alternately predominating during the year."

From these considerations and facts, therefore, we are entitled to conclude that the transfer of American birds to Europe is principally, if not entirely, by the agency of the winds, in seizing them during the period of their migration (the autumnal especially), when they follow the coast or cross its curves, often at a considerable distance from land, or a great height above it. Carried off, away out to sea,

mainly from about the latitude of 45° (the line of greatest intensity of the winds), the first land they can make is that of England, whence the fact that most of the species have occurred in the British islands, as well as Heligoland, equally well fitted to attract stragglers and furnish them a resting-place. It is probable that, apart from their few permanent residents, the Bermudas are supplied in the same manner.

Iceland being in the latitude of the reverse current, from east to west, such of its species as are caught up by the winds and carried off would soon reach Greenland, only a few hundred miles distant. This may be the principal agency of supply from Europe to Greenland, as most European land birds are only met with there at rare intervals; although, as Greenland lies north of Iceland, there may be a regular migration to some extent.

As remarked, the prevailing direction of the winds, whether violent or moderate, throughout the year as well as during the period in which our birds are on either their spring or autumnal migration, is from America towards Europe. Even should their direction be reversed, and that rare phenomenon, a summer "north-easter," occur, it would merely have the effect of bringing the birds back upon our own coast, or into the interior, the line of the storm being, in fact, about parallel with the eastern shore line of the United States, and its influence extending only a short distance from the coast, and not involving the vicinity of Europe at all. That such storms do affect the movements of our birds is shown in the case of the golden plover. It is well known that this species breeds in immense numbers in the northern regions of America, and that the southward migration, in summer or autumn, is principally confined to the region along or near the Atlantic coast. Generally large flights would seem to start directly from Newfoundland and Nova Scotia for the West Indies, where they are met with every autumn passing still southward into South America, and reaching almost to Patagonia. Usually it is but a comparatively small number that touch and rest along the Atlantic states; but it is well known to the sportsmen of New England that, should a violent north-east storm occur off the coast towards the end of August, unusual flights of plover and curlew may be looked for*. This was the case in 1863, when the islands of Nantucket, Martha's Vineyard, and other localities along the coast of Massachusetts swarmed with incredible flights of these birds. On similar occasions immense numbers have been carried far into the interior of the Atlantic states, furnishing the occasion of a regular carnival for gunners, much as in the case of great flights of the wild pigeon.

Another instance of the influence of north-east storms is in the occurrence of the Stormy Petrel (Mother Carey's Chickens) and other oceanic birds far in the interior, and even across the Alleghanies, during and after such storms. The collections of the Smith-

* Mr. G. N. Lawrence mentions (Annals New York Lyceum, 1864, viii. 100) that the golden plover is always found at Montauk Point on the 28th of August, should a north-east storm occur.

sonian Institution embrace specimens of *Thalassidroma Leachii* killed about Washington in August 1842, with hundreds of others. I myself obtained at Harrisburgh, Penn., a fine adult Pomarine Skua (*Cataractes pomarinus*), killed on the Susquehanna, near that city, in September 1839. Adults of the species mentioned are rarely seen within the limits of the United States at all, and in summer the latter would hardly be likely to occur south of Newfoundland.

The present is not the occasion to discuss the nature of that impulse which causes the bird or the fish to retrace its steps in spring so unerringly; the fact is a well-established one, and of much importance in reference to the multiplication or diminution of species. A region deprived of its spring birds or fishes by extermination will only be filled up again in the course of a long period of time. The result, however, can be greatly accelerated by artificial propagation in the places to be supplied.

It may be considered established that the migrations of birds are generally more or less in a north and south direction, influenced very materially by river-courses, mountain-chains, forests, conditions of moisture, mean temperature, altitude, &c. Middendorf (Die Isepiptesen Russlands) suggests that birds migrate in the direction of the magnetic pole—a suggestion not at all borne out by the facts in North America.

It may be further remarked that while birds proceed generally in the spring to the very spot of birth, and by a definite route, their return in autumn is not necessarily in the same line. Many birds are familiar visitors in abundance, in certain localities, in either spring or autumn, and are not known there in the other season. This is a fact well known to the diligent collector; and I have been inclined to think that, in very many instances, birds proceed northward along the valley of the Mississippi, to return along the coast of the Atlantic.

In general the northward vernal movement is performed much more rapidly, and with fewer stops by the way, than the autumnal.

Birds generally make their appearance in given localities with wonderful regularity in the spring, the *Sylvicolidæ* especially—a difference of a few days in successive years attracting the notice of the careful observer; this difference is generally influenced by the season. The time of autumnal return is perhaps less definite.

Observations on the Microscopic Shell-structure of Spirifer cuspidatus, *Sow., and some similar Forms.* By F. B. Meek.

Mr. Meek shows in a paper in Proc. Acad. Nat. Sc. Philad. 1865, p. 275, that the shell of the *Spirifer cuspidatus,* both of American specimens referred to this species, or closely related, and of an Irish specimen of this species received from Mr. Davidson, is clearly punctate, contrary to the decision of Dr. Carpenter. He then asks the question whether two types—a punctate having the internal characters of *Syringothyris,* and an impunctate—may not be included under the species, and suggests the importance of observations with reference to this question.—Silliman's *American Journal,* May 1866.

THE ANNALS

AND

MAGAZINE OF NATURAL HISTORY.

[THIRD SERIES.]

No. 105. SEPTEMBER 1866.

XXIV.—*Notes on some Species of the Orthopterous Genus* Cloëon, *Leach* (*as limited by* M. Pictet). By A. E. Eaton, of Trin. Coll. Camb.

Although but little attention is paid by the generality of entomologists to the Ephemeridæ, the following notes may prove not altogether uninteresting. From reading Dr. Hagen's introductory remarks to his synopsis of the British species of this family (Ent. Ann. 1863) one might be led to imagine that in their early stages of development they are strictly carnivorous. The existence of such a propensity is clearly seen by merely placing a number of pupæ in a small vessel, when the stronger will speedily devour such as they are able to master. But that their diet is partly vegetable also is apparent on an examination of the contents of their alimentary canal; for, in many instances, along with a large proportion of mud, half-digested Diatoms and pieces of Confervæ can be detected. These the animals obtain by nibbling over the surface of water-plants and stones—an occupation to which they are much given. For this work their jaws are admirably suited. In the front are four or five strong sharp teeth, arranged in two rows, whilst behind these is a very singular structure—a flattened transversely striated protuberance, somewhat resembling an elephant's tooth in miniature*. Their subulate antennæ and their unconcentrated abdomen are not the only points in which they resemble Libellulidæ, as, besides the branchial plates of the pupa, the rectum is subservient to purposes of respiration. They seem to be furnished with a muscular cloaca, which is shut off from the extremity of the alimentary canal by a voluntary sphincter muscle. Its external aperture is the anus, through which water is admitted when the insect wishes to inspire. The cloaca being filled, this is then closed, the rectum opens, the cloaca contracts and forces the

* Jaw of the pupa of *Ephemera vulgata*, L.

contained fluid into the intestine, over which ramify branches of the tracheal trunks. The distribution of these tracheæ varies, possibly according to the age of the insect; yet the branches (in a *Cloëon*) which are given off from the trunks in the seventh and eighth segments (Dr. Schaum's method of reckoning) are larger than those in the other segments, especially in young pupæ.

The genus *Cloëon*, as limited by M. Pictet, whom Dr. Hagen follows, may be at once divided into two groups, which in reality are genera, although not recognized as such hitherto. As it is therefore necessary to propose a name for one of them, I will suggest that *Cloëopsis* be given to *C. diptera*, L., on account of a variety of the male resembling in colour *Cloë* or *Cloëon Rhodani*, Pict.

Cloëopsis, nov. gen.

Comprises one widely distributed species, *C. diptera*, L.

Gen. Char.—Pupa with six pairs of double branchial plates and one pair of single ones. Imago dipterous, with two anal setæ, the third abortive.

In this species the larger division of the double branchial plates of the pupa is nearly circular; the smaller is indicated by the dotted line in the figure. The single plates are also circular. It may perhaps be unnecessary to mention that, although Dr. Hagen has included it in his diagnosis of the pupa, the possession of black wing-cases is indicative of state, and is not a special character; in *Cloëon Rhodani*, and some other species also, these organs become black shortly before the final change of the pupa. Dr. Hagen, too, attaches great importance to the markings or absence of colour in the setæ of the imago, as well as to the colour of the turban of the male. But there is scarcely any colour-character which, when fully tested, is not found to vary more or less in the species of this family. Specimens of this insect from Cambridge and Huntingdon often have the turban dull greenish yellow (like the legs of *C. Rhodani* subim.), instead of reddish brown (eyes of house-fly); and in the same localities the female generally has colourless wings, like the male. The setæ are frequently not annulated.

Outline of a double branchial plate.

Cloëon (as restricted).

Gen. Char.—Pupa with seven pairs of single branchial plates. Imago with four wings and two anal setæ; third seta abortive.

Fifth branchial plate of pupa (sp.?).

In this genus the form of the rudimentary hind wings is very useful in determining the species, as it does not vary to any

great extent among individuals of the same kind, whether subimagos or imagos, and it is not much affected by drying. The interneural veinlets on the apical margin of the fore wings are disposed in pairs in the species with round-tipped hind wings, but singly in that with sharp-tipped wings.

C. Rhodani, Pictet.

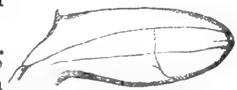
In the ♂ the turban varies precisely as does that of *C. diptera.* The lines on the thorax also are similar to those in that insect in highly coloured specimens. The anal setæ are sometimes entirely white, generally white, with fuscous rings at the joinings and the middle of the joints, seldom fuscous throughout, and become transparent, through tenuity, towards their tips. The imago appears, in favourable weather, throughout the year. A branchial plate of the pupa is figured, I believe, in M. Pictet's work on the Ephemeridæ.

Hind wing, magnified.

C. pumilum, Burmeister.

Subimago. ♂. Turban yellow. Spots and lines of imago all indicated. Legs yellowish white; tarsi, tibiæ, and tips of femora tinged with fuscous. Thorax yellowish fawn-colour. Abdomen pale yellowish grey. Wings and setæ unicolorous, fuscous. Penis black.

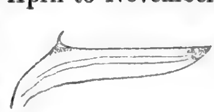
Imago. Turban of male yellow, changing to red when dry. Thorax shiny yellowish brown. Legs yellowish, pale; knees and tarsi darker in the female, but paler in the male. Abdomen in the male whitish yellow, the four apical segments brown: in the female dull yellow brown, with the tips of the dorsal arches darker. Setæ in both sexes white, either annulated with fuscous or not. The hind margins are more delicate, much smaller and narrower than those of *C. Rhodani*, as will be seen on referring to the figures.



Hind wing, magnified.

C. bioculatum, L.

Turban of male cornelian-red, seldom yellow. The imago varies but little in colour. It appears from April to November, if not throughout the year. The figure of the hind wing of *C. bioculatum*, Pict. (Hist. Nat. des Névrop.), differs entirely from the above. His is more like that of Stephens's *bioculatum* (i.e. *C. pumilum*, Burmeister), to which insect *C. bioculatum*, L., when dry, is very similar, size excepted.



Hind wing, magnified.

The above notes were taken from living specimens.

It would be interesting to know more than is known at present about the distribution of the British Ephemeridæ. In Dorset and on Dartmoor *Potamanthus erythrophthalmus* is the commonest of the genus, whilst *P. marginatus* is the most frequent in the Cambridge district. On the Dart *Baëtis montana* predominates, but *B. lutea* at Little Bridy, Dorset. At this last place, too, *Cloëon Rhodani* outnumbers *C. bioculatum*; but at Blandford, in the same county, and at Cambridge the converse obtains. From this it would appear that *P. erythrophthalmus* and *C. Rhodani* are better fitted to inhabit swift streams than *P. marginatus* and *C. bioculatum*.

XXV.—*On the Dentition of* Thylacoleo carnifex (*Ow.*). By Gerard Krefft.

[Plate XI.]

To the Editors of the Annals and Magazine of Natural History.

Gentlemen,

In the December Number of your Journal you figure a tooth which is supposed by Prof. M'Coy to be the hitherto unknown canine of *Thylacoleo carnifex,* because it was discovered "with part of the lower jaw and teeth of *Nototherium Mitchellii,* on which it had probably been feeding." I do not think the finding of such a tooth in proximity with a *Nototherium's* teeth is sufficient proof that it belonged to a *Thylacoleo,* the more so as the huge canine of that animal had never been known before—and *never will be known,* because the *Thylacoleo carnifex* was not furnished with canine teeth, and the dental series (in the lower jaw at least) ended in a pair of incisors, from which fact I venture to conclude (guided by the analogy furnished by the dentition of our living Marsupials with two lower incisors, the wombat excepted) that the upper jaw contained the usual six incisor teeth, and that if it ever possessed a canine it must have been a very small one, corresponding to the diminished tooth found in *Hypsiprymnus* and *Phalangista.*

The tooth described by Prof. M'Coy is not referable to *Thylacoleo*; and the shape of its crown proves it at once to be an incisor, *not a canine,* and most likely the (incisor) tooth of the animal with the remains of which it was discovered. Prof. Owen (who long ago expressed his opinion to the effect that the dental series of the lower jaw of *Thylacoleo* would probably end in a pair of incisors) has given us a full description of the teeth of this animal, to which I have nothing to add, except that, with the scanty material at my disposal, I have ventured to recon-

struct the skull and dentition of this famous marsupial lion (Plate XI. fig. 1), which, in my opinion, was not much more carnivorous than the Phalangers of the present time.

I also enclose drawings of sections of

Lower incisor of	*Thylacoleo*....	*Fig.* 2.
„ „	*Nototherium* ..	*Fig.* 3.
„ „	*Diprotodon* ..	*Fig.* 4.
„ „	*Thylacine*	*Fig.* 5.
„ „	*Sarcophilus* ..	*Fig.* 6.
Upper incisor of	*Felis tigris* ..	*Fig.* 7.
Lower „	„	*Fig.* 8.

showing the relative size of the teeth in these animals, and proving sufficiently that the *Thylacoleo* was far inferior in strength to a modern tiger, and no match for ponderous Diprotodons and Nototheriums. The scale of the photographed fractions is in inches, the sections are of the natural size.

I remain, Gentlemen,

Your most obedient Servant,

Gerard Krefft,

Curator and Secretary.

Australian Museum, Sydney.
May 24, 1866.

XXVI.—*On Two European* Argulidæ, *with Remarks on the Morphology of the* Argulidæ *and their Systematic Position, together with a Review of the Species of the Family at present known.* By T. Thorell*.

Among the various groups which, during the last few years, have attracted the special attention of zoologists, the small Crustacean family of the Argulidæ holds a prominent place. Long represented by one species only, which is common throughout a great part of Europe, and was already, before the time of Linnæus, known as *Argulus foliaceus*, this remarkable family has, in the course of the last thirty years, received a sudden and unexpected accession to the number of its species. Kröyer†, whose writings are the most recent upon the animals composing it, gives the number of known species as thirteen, of which eight have been described since the beginning of the year 1857, and amongst these the three species which constitute Heller's American genus *Gyropeltis*. Of these thirteen Argulidæ, one (*A. giganteus*) belongs to Africa, and one only (*A. foliaceus*) also to Europe; the remaining eleven are all from America.

* Translated, by A. O'Shaughnessy, from the Œfvers. af Kongl. Vetensk.-Akad. Förhandlingar, 21st series, Stockholm, 1864 (communicated 9th Dec. 1863).

† "Bidrag til Kundskab om Snyltekrebsene," Naturhistorisk Tidskrift, 3die Række, Bd. ii. (1863) p. 85.

Under these circumstances it will not be uninteresting to learn that our quarter of the globe possesses two additional species of the family Argulidæ,—one a marine form, from Southern Europe (the Mediterranean), the other a freshwater form, like *A. foliaceus,* and belonging to the middle and northern parts of Sweden. The first of these two species, *Argulus purpureus,* has certainly been already described by Risso under the name of *Binoculus bicornutus* and *Agenor purpureus*; but it seems to have been altogether overlooked by later observers, the reason for which should no doubt be sought partly in the limited circulation which many of Risso's works have attained, partly in that author's usually very insufficient descriptions, which often render the recognition of the species intended very difficult: *Agenor purpureus* is referred to the family Bopyridæ! A new description of this species, of which I found an example at Nice, on the pectoral fin of *Pagellus erythrinus,* will, therefore, not be considered superfluous.

The other, the Scandinavian species, which I call *Argulus coregoni,* is, on the contrary, new to science. My attention was drawn to it through a memoir by Dr. C. L. Nyström*, wherein mention was made of an unusually large *Argulus* as one of the parasites which infest the *Coregonus* in Jemtland. Specimens of this *Argulus* were brought by Dr. Nyström to the Royal Zoological Museum in Stockholm, where also specimens exist from Dalsland collected by Mag. H. Widegren; and through the united kindness of Prof. Lovén and Hrr. Nyström and Widegren, I have had opportunities of examining both Jemtland and Dalsland specimens of this large and well-marked species.

I.

Before proceeding to the description of the animals in question, it will be advisable to state my own conceptions of the various divisions of the body and its accessory organs, which have been very differently interpreted by the authors who have hitherto handled this group. The first great division of the body, which bears the antennæ, the organs of the mouth, and the following two minute pairs of limbs, and which in these animals is developed into a large shield produced behind into two lobes, I call the *head* or *head-shield* (scutum cephalicum); the other, to which the cloven swimming-feet are attached, the *trunk* (truncus), which is followed by a *tail* (cauda) transformed into a leaf-like respiratory plate, bearing two small *appendages,* which, in the newly-hatched larva, are situated at the tip of the tail (as is the

* "Iakttagelser rörande Faunan i Jemtlands Vattendrag," Akademisk Afhandling, &c. (1863), p. 19.

case in the allied forms Phyllopoda and Copepoda), but, in the adult animal, have gradually advanced upwards to the base of the incision which divides the respiratory plate into two lobes. The trunk is named by some authors thorax, by others abdomen, according as they call the first division of the body head (cephalic shield) or cephalothorax; the last segment is, in a similar manner, regarded either as the abdomen or postabdomen, in descriptive works mostly called *cauda*. Kröyer* regards it as the *genital ring*, in consequence of his having, curiously enough, considered it to correspond only to the so-denominated *foremost* segment of the "postabdomen" in the Caligidæ: the appendages of the Argulidæ should, according to him, represent not only the appendages, but the whole of the tail behind the genital ring in the Caligidæ—and hence, naturally, in all the other Copepoda. But the genital ring is nothing but the coalesced first two segments (or only the first segment) of the tail, which in the Copepoda is usually set apart for the functions of generation, and in the Caligidæ and many other (especially the pœcilostome and siphonostome) Copepoda attains a greater development, especially in breadth, than the following caudal segments. The number of these varies much, being four or less: omsetimes, even, the tail remains unsegmented and consists of a single piece, for instance, in some species of the genus *Corycæus*; and just such, in fact, is the stage of development of the tail in *Argulus*. Now, if the unsegmented tail of *Corycæus* corresponds to the tail inclusive of the genital ring in the Caligidæ, which no one presumes to doubt, so also must the tail in the Argulidæ correspond to the *entire* tail in the Copepoda and Caligidæ in general. Still less correct than Kröyer's is Gegenbaur's view of the hindmost segment of the body: Gegenbaur† regards it as consisting of "a pair of partly coalesced branchiæ," and takes it as corresponding not only physiologically, which would have been perfectly correct, but even morphologically with the branchiæ of the Crustacea. Gegenbaur's assertion that this view is shared by Leydig would seem to be the result of a misunderstanding of that author's meaning‡. In the larval state the tail in *Argulus* has a form which easily shows the incorrectness of Gegenbaur's view: it is then exactly like the tail in the older Phyllopod and Copepod larvæ, and bears, as already mentioned, the usual appendages at the tip, between which the anal opening is situated.

If the various body-segments of the Argulidæ have been thus

* *Loc. cit.* p. 88.

† Grundzüge der vergleichenden Anatomie (1859), pp. 245–246.

‡ Vide Leydig, "Ueber *Argulus foliaceus*, ein Beitrag zur Anatomie, Histologie und Entwicklungsgeschichte dieses Thieres," Zeitschrift für wissenschaftliche Zoologie, Bd. ii. (1850) pp. 338–339.

differently regarded, this is certainly the case in a like or even greater degree with the accessory organs, especially the anterior ones or those which appertain to the head. We shall treat of those which belong essentially to the mouth further on, and would begin by directing our attention especially to the four pairs of members which are situated before and behind these. The views taken of these organs, of which we call the two foremost pairs the *first and second pairs of antennæ,* and the two hindmost the *first and second pairs of footjaws,* have, as we have said, been very various, doubtless through erroneous notions of a complete correspondence between the accessory organs of the head in the lower Crustaceans and in the Decapoda, which has rendered the terminology of the former so confused and contradictory*. Of the *antennæ* one pair has usually been considered a pair of *footjaws,*—the first pair by Heller and Cornalia, the second by M.-Edwards and Kröyer. The view we have taken agrees with that given by Dana and Herrick†; and its correctness is shown, not only by the form and position of the corresponding parts in the Phyllopods and Copepods, to which the Argulidæ are most nearly allied, but also by the history of their development. The newly hatched larva of *Argulus* has, as Jurine's‡ and also Dana's and Herrick's figures attest, a pair of antennæ and two pairs of swimming-feet, like the larvæ of the Phyllopods and Copepods; and since the organs which are developed from the antennæ and first pair of jaws in the Phyllopod and Copepod larvæ are now generally regarded as the first and second pair of antennæ, the same rule should be applied to the Argulidæ. A glance at the larva of an *Argulus* shows immediately that the conditions are here just the same as in the case of the Phyllopod and Copepod groups; the sole difference between the Argulidæ and these is that the antennæ in the *Argulus*-larva gradually attain a hooked form, becoming hooked fixing-organs through a stronger development of their two first joints, while the other joints are correspondingly reduced and at last form only a small appendage to the second joint of the antennæ. The first pair of feet in the larva is, as is usual in the allied Crustacea, biramose; the hinder branch already exhibits the form of the adult animal's second pair of antennæ; the foremost branch disappears during the development of the larva.

I should not have dwelt so long on the antennæ of the Argulidæ were it not that Kröyer§ has very lately sought to esta-

* Vide Claus, "Zur Morphologie der Copepoden," Würzburger Naturwissenschaftliche Zeitschrift, Bd. i. (1860) p. 26 &c.

† Descr. of *Arg. catostomi,* Silliman's Journal, vol. xxxi. (1837) p. 298 &c.

‡ Mémoire sur l'*Argule foliacé,* Ann. du Mus. t. vii. (1806) pl. 26. fig 4.

§ *Loc. cit.* p. 87.

blish another view respecting them, tending principally, as it would seem, to discover a nearer affinity between the Argulidæ and the Caligidæ, in which latter group, as in the parasitic Crustaceans in general, it is not the first but the second pair of antennæ which take the form of fixing-organs. According to Kröyer, that which I have called the first pair of antennæ consists of both pairs of antennæ coalesced; the appendage would thus be the first, the claw itself the second pair of antennæ. In accordance with this view, the real second pair of antennæ is regarded as the first pair of footjaws. After what has been already said relative to the history of the development of these organs, a detailed refutation of Kröyer's hypothesis would be superfluous. With regard to the other appendages of the head, a comparison between them in the Argulidæ and the groups allied thereto is rendered difficult by the circumstance that the *Argulus*-larva at its exit from the egg is much more fully developed, and already furnished with the parts belonging to the mouth, and also with the two pairs of limbs situated behind these, so that the origins of these parts cannot be followed genetically. One may, however, conclude from analogy that in the *Argulus*, as in the Phyllopods and Copepods, the mandibles are formed out of the base of the second pair of feet in the larva, and the maxillæ behind them as an independent pair of limbs. How far the two following pairs of limbs in the Argulidæ are originally, as Claus* showed to be the case in the free Gnathostoma and in at least a part of the parasitic Copepoda, branches of one and the same pair of limbs is certainly not clearly ascertained: nevertheless their form and position (especially in the larvæ) exhibit too evident marks of correspondence with the footjaws in the higher families of Siphonostoma to admit of their being regarded in their origin and morphological significance as bearing no relation to these. The first pair seems to serve exclusively as fixing-organs: they take, as is known, in the adult state of the different species of the genus *Argulus* the form of sucking-cups, while in the larvæ and in the genus *Gyropeltis* they are armed at the extremity with a hook. The functions of the second pair are not equally easy to determine; but if they serve to maintain the animal when fastened on its prey, they probably also, and perhaps principally, serve as organs of locomotion, and may therefore be called "creeping-feet" (pedes gressorii), as they have, indeed, been named by Kröyer. Vogt† maintains that the animal avails

* Die frei lebenden Copepoden, p. 28 (1863). "Ueber den Bau und die Entwicklung von *Achtheres percarum*," Zeitschrift für wiss. Zool., Bd. ix. (1861) p. 293.

† "Beiträge zur Naturgeschichte der Schweizerischen Crustaceen," Neue Denkschriften der allg. Schweizerischen Gesellschaft für die gesammten Naturwissenschaften, Bd. vii. (1845), p. 12.

itself of these "for cleaning the sucking-cups and for removing extraneous particles from the cavity." Their first joint usually shows on the underside a plain, sharply-defined surface, which, posteriorly, is mostly produced into three strong teeth, and which we therefore, in common with Kröyer, call the comb ("kammen," *pecten*).

Immediately behind the base of the second pair of antennæ is a strong chitinous tooth or hook, which is regarded by Kröyer as a *palp*. In position and external appearance it agrees, indeed, with the hook, frequently occurring in the Caligidæ (the first pair of maxillæ, according to M.-Edwards and others), which Kröyer designates "antennpalp," but is called "accessory hook of the second pair of antennæ" ("hjelpkrok," *hamulus*) by Steenstrup and Lütken*, and is not regarded, therefore, by them as belonging to the true series of appendages, but as a cuticular growth appertaining to the dermal framework. This view seems to be shared also by Claus, and is, in my opinion, the correct one, both as regards the Caligidæ and the Argulidæ. With respect to the latter, this is indeed evident from the circumstance that the Argulidæ often possess two extra pairs of perfectly similar hooks,—the one between the second pair of footjaws, the other behind these, before the base of the first pair of swimming-feet, which hooks cannot easily be looked upon as reduced appendages or parts of such. On the basal joint of both the first and second pairs of antennæ and the second pair of footjaws the chitinous covering is also developed into similar hooks; and certain parts of the underside of the body, especially the border of the head-shield anteriorly, are usually thickly set with small teeth, which have a similar significance with the larger hooks previously mentioned, and, like them, serve to fix the creature on the spot to which it has attached itself by suction or clinging. All these hooks and teeth have, accordingly, the apex directed backwards, and thus prevent the animal from sliding or being brushed from before backwards, the only direction in which any strong pressure under ordinary conditions could operate. This modification of cuticular structure should consequently be stronger in those species which principally subsist on the outer integument of fishes, as, for instance, *A. foliaceus, coregoni, purpureus,* and weaker in such as subsist in the gill-cavity, like *A. catostomi*.

It remains for us briefly to account for the *true mouth-organs* in the Argulidæ, as far as these are known to us. Former authors who have occupied themselves with researches concern-

* "Bidrag til Kundskab om det aabne Havs Snyltekrebs og Lernæer, &c.," Kongl. Danske Vidensk. Selsk. Skrift. 5te Række, Bd. v. (1861) p. 350.

ing *Argulus foliaceus,* and even the distinguished Jurine*, assumed that the oral aperture was situated at the tip of the anteriorly produced sting (" gadd," *aculeus* or *stimulus*) in that animal, and consequently missed all acquaintance with the essential parts of the mouth. For the first exact description of these parts in an Argulid we have to thank Dana and Herrick, who, in their admirable memoir already cited, on *Argulus catostomi,* have given an accurate representation of the structure of the mouth-tube in that American species, and have shown that it contains two pairs of organs. These they designate *inner* and *outer maxillæ* ; the sheath itself which contains these they regard as corresponding to the *mandibles,*—a view which is in accordance with these authors' attempt to show a like segmentation and number of the appendages in the Argulidæ to those which obtain in the Decapoda—consequently, as in those, one pair of mandibles and two pairs of maxillæ.

Several years later Vogt gave a description of *A. foliaceus,* in which Jurine's mistake as to the position of the mouth is rectified; but the exposition which Vogt puts forth of the oral organs is far from clear, as is the case also with the figure which accompanies it. The following is Vogt's description :—" The opening of the mouth is situated in a club-shaped projection behind the 'sting,' protected on each side by two ring-like horny plates inclined inwards; and on the inner surface of these are seen two smaller plates of similar appearance. A singular S-shaped double lip is seen below, which is inclined upwards, and opposed to a single horny piece bent over the opening above."

Leydig, who has written an excellent memoir on the inner conformation of *A. foliaceus,* has also briefly named the oral organs and described them as follows :—" The opening of the mouth is placed in a club-shaped projection bent downwards. It is bounded posteriorly by a crescent-shaped lower lip, anteriorly and laterally by two broad gradually tapering plates. Several disk-like pieces inside represent the mandibles."

It will be seen that this description also is not satisfactory, since it gives no further light on the form and number of those parts which are said to correspond with the mandibles. These two authors, Vogt and Leydig, would seem to be the only ones who have given any exposition of the armature of the mouth in *A. foliaceus* based on independent researches. Others, as Milne-Edwards and Baird†, have, further, applied to the European species Dana's and Herrick's representation of the structure of the oral organs in the American *A. catostomi* ; but how

* *Loc. cit.* p. 440.
† Nat. Hist. of Brit. Entomostraca (1850), p. 248.

hazardous such a proceeding is appears at once from the fact that, according to Heller's description, the mouth-tube in another American species, *A. Nattereri,* only contains *one* pair of chewing-organs, of an entirely different appearance from the corresponding parts in *A. catostomi.* That considerable differences exist also between the oral organs of *A. foliaceus* and *A. catostomi* is apparent at once on a comparison of Dana's and Herrick's description and figures of, for instance, the mandibles and maxillæ in the latter species with the account given further on of the same parts in *A. foliaceus.* According to Heller and Cornalia, the genus *Gyropeltis* agrees with *A. Nattereri* in having only *one* pair of jaws in the mouth-tube. In that genus this consists apparently of an upper lip anterior and a lower lip posterior to the jaws; in the Argulidæ which have a sting ("gadd") before the mouth-tube, this latter must be formed of the lower lip only, whereas the "sting" is a transformed upper lip, as indeed Vogt and others have held.

Of the authors who have described the Argulidæ none have advanced further than those already quoted towards a clear exposition of the nature of the mouth; the only species with respect to whose oral organs we possess satisfactory information are consequently *Argulus catostomi* and *Nattereri,* together with the three species of the genus *Gyropeltis.* Even Kröyer, who was the last to occupy himself with these animals, and who gave complete descriptions and figures of several species of them, neglects the structure of the mouth to such an extent that he does not even inform us whether his species possess a sting ("gadd") or not—a point all the more important since, to judge from his figures, they seem to lack that organ whose presence would constitute one of the characters distinguishing *Argulus* from *Gyropeltis.* As to the form and number of the footjaws no information whatever has been vouchsafed. It is, however, evident that a natural arrangement of this rapidly enlarged group, without a knowledge of the structure of these important organs, must be impossible or in a high degree difficult to arrive at.

Of *Argulus foliaceus* I have been able to have recourse to a few specimens in spirits only; consequently the following description of its oral organs is not so complete as I could have wished. The structure of the sting ("gadd") is given with sufficient accuracy by Vogt and Leydig, and may therefore be passed over here. Its function is probably only that of an irritating organ, whose puncture occasions a strong flow of blood to the spot where the animal is about to suck.

The mouth-tube has, as is known, a recurved, conical, or club-like appearance; in a very young specimen I have fancied I perceived signs of a suture of some extent along

the front, whence I conclude that both borders of the lower lip have coalesced with each other in the formation of the mouth-tube. Above, before the middle of the front surface, two small teeth are observable. Laterally, its diameter is almost the same throughout; and the club-like shape depends consequently on the fact of its being somewhat broader at the extremity. The tip itself is obliquely truncated, and shows behind a hood-like extension of the wall of the tube, which spreads itself over the back part of the oral aperture in the form of a large, moveable, almost crescent-shaped lip. The almost triangular oral aperture is bounded by the two posterior (inferior) arms of an almost H- or X-shaped chitinous structure or apparatus, as also by two thin, oblong, chitinous lamellæ, which are rounded at the extremity, and are situated immediately beneath these, and whose direction is parallel with them: on the inner margin these latter show some few saw-like teeth. Both these lamellæ I regard as maxillæ.

Somewhat higher up in the tube are placed the two mandibles. They are oblong, almost triangular, somewhat curved, and end on either side in a finely pointed apex, above and before which the convex (lower and inner) margin is raised into two smaller and two stronger teeth. These mandibles are directed with their tips towards each other, inwards and upwards, in the gullet, while the maxillæ diverge backwards and outwards.

In order to give suppleness to this armature, and at the same time to support the mouth-tube itself, this last contains a rather complicated chitinous framework. Such a framework is apparent on either side of the tube, and involved in its wall, being somewhat thickened beneath the crescent-shaped lip, where it forms a knob on either side of the tube. This knob furnishes the principal support for the mandible. Two other such chitinous processes, which are placed more inwards and backwards in the tube and do not touch its walls, extend below the lip, whose arch they seem to support, and form here a bow by means of which they unite with the two side processes. The X-shaped chitinous framework which bounds the oral aperture is also brought into connexion with these processes by means of its arms, and thus, at the extremity of the mouth-tube, is formed a solid apparatus.

The gullet ascends as a slender, *strongly chitinous* tube, and proceeds backwards in a bowed shape through the nervous ring situated in the throat to the stomach, where it opens, by means of a remarkable cup-like organ, into a cardia or *stomach-mouth* ("mag-mun"), which probably acts as a sucking-pump. I think it probable that the maxillæ serve to effect an opening

in the integument of the animal upon which the parasite has fixed itself, and that the imbibed blood-corpuscles, on their way through the narrow gullet, are broken and ground by the mandibles.

In those forms (for instance the species of the genus *Gyropeltis*) which lack maxillæ, the mandibles are placed close to the opening of the mouth, and may, being strongly toothed on the lower border, unite the functions which we observe to belong to the mandibles and maxillæ in *A. foliaceus* and the allied species.

Within both mandibles and maxillæ other perfectly similar mandibles or maxillæ are usually perceptible, differing from these only in being somewhat smaller. These are probably formed to replace the older external organs when a change of the integument takes place: a similar supplemental structure is found in the claw of the antennæ of the first pair. In *A. coregoni* the oral organs exhibit almost the same formation as in *A. foliaceus*. *A. purpureus* differs especially in having the mandibles situated lower down, close to the opening of the mouth, and in the maxillæ being destitute of teeth on their inner border. The lip also has a different form.

After these remarks on the morphology of the Argulidæ we pass on to the description of our two species, *A. purpureus* and *A. coregoni*.

II.

Argulus purpureus, Risso *.

Syn. *Binoculus bicornutus*, Risso, Hist. Nat. d. Crustacés de Nice, (1816) p. 170.

Agenor purpureus, Risso, Hist. Nat. d. princip. prod. de l'Europe mérid. tom. v. (1826) p. 139, pl. v. fig. 28.

Scutum cephalicum maximum, oblongum, multo longius quam latius, in lateribus parum rotundatum, antice utrinque profunde sinuatum, postice anguste et profunde incisum, pedes omnes totamque caudam tegens; segmentum trunci ultimum utrinque lamina foliacea præditum; cauda ampla, latissima, dimidiam reliqui corporis longitudinem æquans, vix ad medium incisa, laciniis acuminato-rotundatis; stimulus longissimus; sipho subcylindratus; cotyledones parvi, diametro $\frac{1}{10}$ longit. corporis æquantes; pecten plaga media scabra nulla, dentibus tribus acutis; pedes flagello carent.—Longit. circa 18, lat. 10 millim. (♀).

Hab. in Mari Mediterraneo ad Nicæam, in *Selenia* (*Carangi*) *luna* (Geoffr.)

* Although the name *bicornutus* is older than *purpureus*, we prefer the latter, on the ground that the former appellation is based on a false appreciation of the antennæ; we have less hesitation in doing this, since no *personal* right of priority is thereby affected.

a Risso, et in *Pagello erythrino* Cuv. a me ipso inventus. Plerumque in pinna pectorali piscis parasitat.

Descr. FEMINÆ. *Scutum cephalicum* maximum, totum truncum cum caudà et pedibus tegens, plus dimidio longius quam latius, æqualiter convexum, antice ad lobum frontalem abrupte sinuato-angustatum, angulis utrinque rotundatis, lateribus subparallelis, parum rotundatis, fissura angustiore, fere ad medium scuti longitudinis ducta bipartitum, laciniis apice late et oblique rotundatis; supra læve, subtus ad margines antice, præsertim capitis, denticulis minutissimis dense sparsum. Pars *media* (cephalica) medio scuto duplo angustior, latitudine plus dimidio longior, margine antico (frontali) rotundato-triangulo, sulco utrinque valde manifesto, forma fere literæ S, a reliquo scuto separata et costis duabus chitinosis, in medio appropinquantibus, ut in *A. foliaceo* cet., prædita.—*Truncus* convexus, postice paullo angustatus, segmentis duplo latioribus quam longioribus; segm. quarto utrinque laminam oblongam, incurvam, apice rotundatam, caudæ dorso impositam gerentie. *Cauda* maxima, eadem circiter longitudine ac latitudine, segmentis 4 trunci conjunctim non brevior, $\frac{1}{3}$ totius corporis longitudine æquans, in lateribus rotundata, antice ad segm. trunci quartum excipiendum angulis rotundatis subemarginata, postice fissura, fere ad medium longitudinis ducta, in duas lacinias rotundato-triangulas divisa. *Appendices* minutæ, cylindratæ, diametro multo longiores.

Oculi sat parvi, semilunati. *Macula ocellaris* ab oculis multo longius distat, quam illi inter se.

Antennæ in fovea communi utrinque ante oculos locatæ marginem capitis minime attingunt. *Ant. primi paris* robustæ; art. 1^s brevis, subtriangulus, aculeo forti armatus; art. 2^s oblongus, brevior et crassior quam in *A. coregoni* et *foliaceo*, apice in uncum fortissimum incurvo, angulo vel dente acuto antrorsum et intus directo ad basin in latere anteriore, uncoque forti fere in medio lateris posterioris armatus; *appendix* tenuis, parum ultra apicem antennæ pertinens, articulis 2: art. 1^s latitudine multis partibus longior, in apice postice seta brevi, lata, acuminata instructus, art. 2^s fere triplo brevior et paullo angustior quam art. 1^s, subacuminatus.

Ant. secundi paris longitudine priorum, at inter se multo longius distantes, ad basin crassæ, extus tenues, articulis 5, subcylindratis. Art. 1^s diametro paullo longior, unco forti ad basin postice; art. 2^s prioris fere crassitudine, sed duplo brevior, apice antice rotundato-fornicato, articulum 3^m postice gerente, qui articulus 3-plo angustior est, subcurvatus, diametro 3–4-plo longior, in latere anteriore pilosus; art. 4^s priore duplo angustior et paullo brevior est, versus apicem pilosus; art. 5^s eo etiam angustior et duplo brevior, subangustatus, in apice subpilosus.—Pone antennas dens vel *uncus auxiliaris* fortis utrinque adest, cum unco art. primi antenn. primi paris trapezium latius quam longius formans.

Stimulus longissimus est, et sulco profundo, lato, antice dilatato, in lateribus transverse striato, apice acuminato inter antennas secundi paris ducto excipitur; vagina verticulam ad basin ostendit et sulco illo longior est; porrectus ultra antennas primi paris pertinere videtur.

Sipho tenuis, subcylindratus, in lateribus subsinuatus, in apice circa $\frac{1}{5}$ millim. latus, diametro saltem 3-plo longior, retro et deorsum directus, paullo pone stimulum oriens, paullo ultra basin maxillipedum secundi paris pertinens. Apex *labio* transverso rotundato-triangulo, forma fere cuculli, subtus aperto efficitur, cujus in fundo *apertura oris* se ostendit, maxillis definita. Margo labii in media parte membranula tenuissima, striata auctus. *Maxillæ* oblongæ, apice rotundatæ, in margine interno non dentatæ, divaricantes, ad basin costa lata, chitinosa conjunctæ. *Mandibulæ* transverse positæ, in ipsa apertura oris apparentes, ad basin latæ, subquadratæ, tum repente supra angustatæ, reliqua parte oblonga, subangustata, in margine inferiore versus apicem et in ipso apice obtuso dentibus paucioribus armatæ.

Cotyledones (*maxillipedes primi paris*) parvæ, diametro $\frac{1}{10}$ longitudinis totius corporis vix superantes, radiis marginis circa 65.

Maxillipedes secundi paris breves, basi fortes, articulis 3 ultimis tenuioribus. Ex articulis 5 constare videntur : art. 1^s foras directus crassissimus, postice convexus, *pectine* postice latiore, antice rotundato, latitudine paullo longiore, glabro, plaga scabra nulla, dentibus 3 minoribus acuminatis eademque fere magnitudine armato. Art. 2^s angustior et brevior, subconicus, deorsum et antrorsum directus, articulo vel *patella* quasi auctus, quæ instar cotyledonis supra basin articuli proximi eminet. Articuli sequentes retro et paullo foras directi sunt : art. 3^s subcylindratus, latitudine duplo longior ; art. 4^s paullo angustior, latitudine non longior, intus rotundato-dilatatus ; art. 5^s minutus, priore dimidio brevior at multo angustior, subovatus, intus versus apicem abrupte angustatus, inermis.

Inter basin maxillipedum secundi paris adsunt *dentes* vel unci duo, fortes, cum aliis duobus multo minoribus pone eos sitis trapezium postice latius formantes.

Pedes breves, tenues, ultra marginem scuti vix prominentes, *flagello carentes*. Par. $1–3^m$ eadem fere sunt forma et longitudine, *stipite* compresso, subæquali, articulis 3, quorum 1^s brevissimus est, 2^s diametro breviore dimidio longiore, 3^s ad apicem rotundato-acuminatus, diametro illo vix vel parum longior. *Rami* parvi, stipite dimidio ad duplo breviores, ad basin crassi, extus acuminati, ramo *superiore* crassiore et paullo longiore, in marginibus pilosi. Ramus *inferior* pedum *tertii paris* differt in eo, quod ex articulis 2 constat, primo breviore et crassiore, subcylindrato, diametro fere duplo longiore.

Pedes quarti paris reliquis dissimiles, magis retro directi, et ita segmento ultimo trunci affixi, ut angulum rectum inter se forment. *Stipes* ex 2 articulis constat : art. 1^s basi truncatus et subrectangulus est, extus latitudine brevior, intus ita angustato-productus, ut duplo longior quam latior evadat, normæ formam simulans. Excipit extus artic. 2^m, qui eadem fere est longitudine, subcylindratus, in latere interiore leviter rotundatus, diametro plus duplo longior. *Rami* longitudine circiter articuli prioris, forma ut in pedibus tertii paris, art. primo rami inferioris multo crassiore et parum breviore quam art. 2^s.

Color (in vivo) : scutum cephalicum pallide cæruleo-virescens,

rarius albo punctatum, vittis in utraque ala 3 violaceis, parallelis, versus apicem scuti latioribus et confluentibus, et linea tenui, obscurius violacea, antice introrsum geniculata, inter vittas duas interiores ducta. Lobus frontalis margine subviolaceo. Rami gastrici luteo-fusci. Ovarium in dorso perlucens album, dense violaceo punctatum, linea media ad longitudinem ducta, purius alba geminatum. Cauda scuto pallidior, densius albo punctata, versus apicem et in margine externo pallide violacea, vitta violacea ad marginem internum, receptaculis seminis obscure fuscis. Truncus subtus in medio late fuscus, in lateribus albicans, ipso margine cum stipite pedum cæruleo-virescens. Dentes corporis, partium oris, maxillipedum cet., cum annulo chitinoso cotyledonum fusci. Partes oris ceterum, ut rami pedum, hyalinæ.

With regard to the *internal conformation* of the animal, I have only the following to communicate. It differs from *A. foliaceus* in the fact that the large side branches of the stomach send out smaller branches, not only on the outer but on the inner side also. The outbranchings of the stomach are on the following plan:—Immediately before the first pair of legs the stomach sends out on either side a strong, outwardly and somewhat backwardly directed stem, which, when it has attained almost the middle of the wing of the shield, bends backwards at almost a right angle, sending immediately a strong stem forwards. This divides soon after into two smaller stems, which stretch backwards towards the end of the shield, and on either side send forth numerous branches and subbranches, which, however, never anastomose with one another. Even the short anteriorly directed stem branches forward in the same manner. In all these vessels the rhythmical pulsating backwards and forwards of the brownish-yellow contents is perceptible in the living animal. The circulation of the blood is particularly evident in the broad and thin tail.

The *ovary* reaches far forward between the second pair of footjaws, and is therefore somewhat pointed at its anterior extremity. It is long and narrow (7 millim. long, 2 millim. broad), and contains a great many eggs, closely packed and adhering together, about $\frac{1}{3}$ millim. in length and $\frac{1}{4}$ millim. in breadth. The eggs show the same formation and appearance as in *A. foliaceus* and *A. coregoni*. In the living animal the ovary is transparent through the back as a whitish, thickly violet-dotted organ, divided lengthwise by a clear white band. Of this fine species I obtained a single specimen in Nice on the 8th March, 1862, a female, fastened upon the inside of the pectoral of *Pagellus erythrinus*, Cuv. The right lobe of both the head-shield and the tail are somewhat shorter in this specimen than the left, which is undoubtedly only an accidental variation.

Risso found this species at Nice, in the month of May, on

Selenia luna (Geoffr.), Bonap. (*le Caranx magnifique, Citula Banksii,* Risso), commonly attached to the base of the pectoral of that fish. The female was unknown to him: the male is distinguished by "deux petits tubercules coniques, blanchâtres .... situés à la base de la dernière paire de pattes." In colour it is said to be "d'un pourpre violâtre, traversé par six lignes longitudinales parallèles, blanchâtres." The description in 'Hist. Nat. d. Crustacés de Nice' is extremely detailed, but contains many inaccuracies. The description in 'Hist. Nat. d. princ. prod. de l'Europe mérid.' would seem to be only an abstract of the former. It is accompanied by a figure, in which it is not easy to recognize an Argulid. In his first-mentioned work, Risso gives correctly the affinities of the animal, and places it in Geoffroy's genus *Binoculus,* under the name of *B. bicornutus.* But in the later work we search in vain for either *Binoculus* or *Argulus*; with his usual superficiality, Risso there removes the animal to the family *Bopyridæ,* under the name of *Agenor* (n. g.) *purpureus,* by the side of species of the genera *Bopyrus* and *Cecrops*! *A. purpureus* deserves, more than any other species of *Argulus,* to be made the type of a distinct genus (*Agenor,* Risso). Besides the unusual development of the head-shield, it is especially characterized by the absence of the "tassel" or flagellum ("gissel") on the anterior pairs of legs, as also by the two lamellæ on the last segment of the trunk. The parts of the mouth also show a somewhat different structure, as does the second pair of maxillipeds, in the peculiar "patella" which is inserted between the second and third joints of these limbs.

Argulus coregoni, n. sp.

Scutum cephalicum antice utrinque subsinuatum, in ♀ inverse subovatum, vix longius quam latius, pedes ultimi paris non tegens, in ♂ amplissimum, suborbiculatum, laciniis apice se invicem et omnes pedes tegentibus; cauda ovata, longitudine $\frac{1}{3}$ reliqui corporis superans, saltem ad medium incisa, laciniis apice lanceolato-acuminatis; art. 1s antenn. secundi paris dente minuto armatus; stimulus minutus; sipho subcylindratus; cotyledones sat parvæ, diametro $\frac{1}{8}$–$\frac{1}{9}$ longitudinis corporis æquantes; pecten plaga media oblongo-rotundata scabra, dentibusque 3 conicis, acuminatis.—Long. ♀ usque ad 13, latit. ad $8\frac{1}{2}$ millim.; ♂ longit. $10\frac{1}{2}$, latit. 8 millim.

Hab. in lacubus majoribus Sueciæ mediæ et septentrionalis; in Storsjön aliisque lacubus Jemtlandiæ a Dr. C. L. Nyström in *Coregono lavareto* Linn. et *Thymallo vulgari* Nilss. inventus; in Laxsjön Dalslandiæ in *Coregono lavareto* et in lacu Vettern in *Salmone trutta* Linn. a Dr. H. Widegren quoque captus. In cute externa piscium parasitat.

Descr. Feminæ. Corpus in universum eadem est forma atque in *A. foliaceo*: ovatum, depressum, supra modice convexum. *Scutum*

cephalicum inverse subovatum, longitudine maximam latitudinem (paullo pone medium) parum superante, in lateribus æqualiter rotundatum, antice utrinque sinuatum, lobo frontali æqualiter rotundato; postice late at non profunde (vix ad tertiam longitudinis partem) excisum, laciniis, a parte posteriore segmenti primi trunci orientibus, in margine interiore sinuatis, apice rotundatis, fere ad medium segmenti ultimi trunci pertinentibus. *Truncus* tertiam scuti partem latitudine æquans, quoad liberus est parum longior quam latior, postice rotundatus et subangustatus, segmentis subæqualibus, duplo latioribus quam longioribus, ultimo tamen prioribus breviore sublunato. *Cauda*, longit. $\frac{1}{3}$ totius corporis haud æquans, $\frac{1}{4}$ vero multo superans, oblonga est, subovata, basi angusta trunco affixa, in lateribus subrotundata, profunde, plerumque ultra medium, fissa, laciniis latitudine duplo longioribus, apice lanceolato-acuminatis. Ad basin caudæ subtus eique adnata adest lamina parva, breviter subovata, apice in formam trianguli inciso, longitudine diametrum artic. ultimi pedum quarti paris haud superans. *Appendices* supra in fundo fissuræ minutissimæ sunt, cylindratæ, diametro circa 3-plo longiores, in apice pilis 4–5 instructæ.

Oculi rotundati, oblongi, inter se paullo longius quam a margine capitis distantes. *Macula ocularis* cum oculis triangulum æquilaterum format.

Antennæ utriusque lateris, e callo obliquo exeuntes, foras et antrorsum directæ sunt; latera capitis ad eas excipiendas utrinque in foveam sunt excavata. *Ant. primi paris*, inter se sat longe distantes, ex art. 2 constant: 1^s brevissimus, aculeo forti subtus armatus; 2^s oblongus, extus angustatus et in unguem fortem, incurvum productus, tuberculo foras directo versus basin in margine anteriore, in margine vero posteriore, paullo supra hoc, unco forti armatus. E latere articuli superiore et posteriore, infra medium ejus affixa, excurrit *appendix* longa, tenuis, angusta, parum ultra ipsam antennam pertinens, articulis 2, primo longo, subæquali, in apice setam fortem et articulum secundum gerente, hoc art. illo triplo saltem breviore, paullo angustiore, duplo longiore quam latiore, apice rotundato, piloso.

Antennæ secundi paris prioribus paullo breviores sunt et fere duplo longius inter se remotæ, articulis 5: 2 primis crassis, reliquis tenuibus. Art. 1^s fere æque latus ac longus, in latere postico dente minuto armatus; art. 2^s paullo angustior, et duplo fere brevior; art. 3^s multo angustior quam art. 2^s, latitudine duplo longior; art. 4^s etiam paullo angustior et brevior; art. 5^s priore paullo brevior et duplo angustior. Omnes art. in apice pilis aliquot brevibus instructi. Paullo pone antennas utrinque adest *uncus auxiliaris* fortissimus, callo illo antennarum ab iis divisus, unco articuli primi antenn. primi paris robustior. Quattuor unci, quorum meminimus, trapezium formant antice latius, latitudine antica fere duplo brevius.

Stimulus in medio inter cotyledones oriens, sulco profundo, usque inter antennas primi paris ducto receptus, tenuis est et brevis, parum conspicuus, ad basin antennarum secundi paris, versus quam porrigitur, nullo modo pertinens, vagina tertiam partem longitudinis sulci fere æquante.

Sipho e sulco stimuli in medio inter cotyledones surgens, retro et deorsum directus, basi innititur costis duabus crassis, postice divaricantibus, foveam latam et profundam definientibus. Brevis est satisque tenuis, non ad basin maxillipedum secundi paris pertinens, diametro plus duplo longior, subcylindratus, versus apicem tamen paullulo incrassatus, ipso apice planitiem fere libratam formante. Tubum format tenuem, costam utrinque fortem chitinosam, ipsi parieti siphonis innatam, a basi ejus versus apicem ductam, aliasque duas ejusmodi costas liberas includentem. Quæ costæ omnes in apice siphonis ad pegma satis complicatum, instrumenta manducationis gerens, formandum concurrunt. Ipsa *apertura oris*, quæ forma fere trianguli est, postice definitur labio quodam mobili, semilunato, cuculli instar, in lateribus vero *maxillis* duabus oblongis, divaricantibus, in apice rotundatis, in margine interno subrecto dentatis, callo chitinoso fere H- vel X-formi ad basin (antice) conjunctis, qui callus cum costis illis chitinosis quoque conjunctus est. Etiam profundius observantur *mandibulæ*, transverse positæ, oblongæ, basi latæ, versus apicem angustatæ et sursum subcurvatæ, in apice aculeis minutis quasi pilosæ, ante apicem in margine convexo (inferiore et interiore) dentibus tribus gradatim majoribus, ultimo in apice bifido, armatæ. Ipsa mandibula et maxilla plerumque aliam mandibulam vel maxillam *supplementarem* includit.

Cotyledones (*maxillipedes primi paris*) sat parvæ, $\frac{1}{6}$–$\frac{1}{7}$ longitudinis scuti diametro apicali æquantes, a margine scuti et inter se paullo plus quam diametro illo distantes. Radios marginis plus 80 numeravi; ipse margo plerumque inæqualiter dentatus, quasi lacerus est.

Maxillipedes secundi paris extensi non ad marginem scuti pertinent. Art. 1^s brevis, crassus, postice valde convexus; *pecten* obliquus, in margine interiore fortiter sinuatus, latitudine media fere duplo longior, plaga dentibus hispida rotundata, oblonga, subobliqua, maximam latitudinis partem occupante præditus dentibusque 3 fortibus, longis, acuminatis armatus. Art. 2^s versus apicem angustatus, latit. media duplo longior; art. 3^s eo multo angustior, duplo brevior, subcylindratus; art. 4^s etiam angustior, subquadratus; art. 5^s priore minor, oblongus, apice in digitum, articulo minuto auctum excurrente et 2 aculeis minutis, curvatis armato.

Inter maxillipedes secundi paris adsunt dentes vel *unci* duo, et pone eos alii duo, ante basin pedum primi paris siti, qui prioribus paullo minores sunt et paullo magis inter se remoti.

Pedes versus apicem satis æqualiter angustati, e stipite compresso binisque ramis consistunt, primi et secundi paris flagello introrsum directo præterea instructi. *Par.* $1–3^i$ eadem fere longitudine sunt, ultra marginem scuti pertinentes, primi paris reliquis tamen paullo breviores. *Stipes*, in latere posteriore versus apicem pilis plumatis vestitus, ex 3 articulis parum distinctis compositus est. Art. 1^s omnium parium brevissimus est; art. 2^s ordine gradatim paullo brevior, art. 3^s gradatim paullo longior evadit: art. 2^s diametro breviore fere duplo (primi paris)—vix dimidio longior est; art. 3^s priore fere duplo (primi paris)—parum brevior, paulloque angustior,

versus apicem subangustatus, diametro illa non (primi paris)—dimidio longior. *Rami* stipite paullo longiores, æqualiter angustati, subrecurvi, pilis crebris longis, plumatis, curvatis in latere posteriore et versus apicem vestiti, non distincte annulati; ramus *superior* inferiore parum longior est, at versus basin multo crassior. *Flagellum*, quod prope apicem art. 3[i] stipitis in latere ejus superiore initium capit, longitudine stipitis est, tenue et angustum, parum curvatum, in margine postico plumato-pilosum, in apice setis 2 fortibus, curvatis instructum. Ramus *inferior* pedum *tertii paris* (ut et quarti paris) a reliquis in eo differt, quod verticula manifesta in duos articulos divisus est, art. 2° altero dimidio longiore.

Pedes quarti paris, qui non a scuto teguntur, prioribus paullo breviores sunt, stipite præsertim breviore, articulis tantum 2, in margine postico toto plumato piloso. Art. 1[s] latitudine brevior est, basi postice in lobum rotundatum, oblique introrsum directum productus; art. 2[s] paullo angustior, versus apicem subangustatus, diametro breviore dimidio longior. *Ramus inferior* paullo ante medium verticula in duas partes divisa.

Color (in exemplis in spiritu vini asservatis) virescens, albicans vel rufescens. In alis scuti subtus valde manifestæ sunt plagæ duæ, colore pallidiore, nigra linea limitatæ, anteriore parva, posteriore magna, oblonga, a maxillipedibus secundi paris usque inter pedes secundi et tertii paris pertinente. Cauda ad basin supra plagam fuscam, interdum in duas divisam ostendit, cujus ad basin receptacula seminis maculas duas rotundatas fusciores formant.

Mas in eo presertim a femina differt, quod scutum cephalicum multo est amplius, æque latum ac longum, suborbiculatum, omnes pedes et basin caudæ tegens, laciniarum lateralium altera alteri ita incumbente, ut spatium parvum, subtriangulum tantum inter se relinquant. Lobus frontalis latior, minus rotundatus, subtruncatus. *Cauda* lamina illa parva ad basin subtus caret; laciniæ ejus acutiores sunt, *appendices* angustiores: *testes* inverse et anguste ovati, a basi ultra fissuram porrecti, longitudine $\frac{2}{3}$ caudæ non æquantes.

Pedes parium 2–4[i] quoque a feminæ diversi sunt, *instrumentis copulationis* præditi. Art. 2[s] pedum *secundi* paris in latere postico tres procursus rotundatos ostendit, duos infra, quorum alter prope basin, alter versus apicem situs est, tertius supra, versus basin articuli. Flagellum horum pedum longius est quam pedum primi paris. Pedes *tertii paris* magis etiam diversi: in latere *anteriore*, supra, art. 2[s] ad basin eminentiam parvam, fere semicirculatam gerit, et prope hanc, ad apicem, in dentem mollem productus est; art. 3[s] procursum longiorem, apice rotundatum, huic denti quasi incumbentem ad basin ostendit; in latere *posteriore* adest eminentia major, fere semicirculata, art. 2° et 3° conjunctis imposita (*capsula seminis*), et ipse ramus superior horum pedum basi in formam dentis versus procursum illum productus est. Pedes *quarti paris* art. 1[m] non adeo introrsum dilatatum habent atque in ♀; art. 2[s] brevior est, quam in illa, in latere anteriore versus apicem procursu forti armatus, cujus apex in aculeos vel digitos excurrit, uno (intimo) eorum subincurvo, apice incrassato et rotundato, in latere concavo denticulato.

Internal structure.—As is the case in *A. foliaceus,* the central portion of the nervous system is highly concentrated. Essentially the two species agree in what concerns this portion of the nervous system; but there are still many differences which it is not difficult to detect. In *A. coregoni* the ventral series of ganglia reaches only from the throat to the base of the second pair of footjaws, and is about $1\frac{1}{2}$ millim. long. This proceeds with two short strong arms encircling the throat to the *brain,* which seen from above is almost quadrate, though somewhat longer than broad, rounded behind, diminishing somewhat anteriorly, and here giving off the two strong nerves for the organs of vision. From above the brain shows the usual portion dilated into three lobes and bears the single ocellus. The *ventral cord* consists of six ganglia, which are situated close upon one another, without any well-marked commissure, but are all evidently separate. The *first* ganglion is much longer than the others, rounded, and separated by a stronger constriction from the rest of the series. The five following ganglia form a common, oblong division, which is somewhat diminished towards the extremity. The last ganglion is rather longer and smaller than the foregoing, the breadth of which is more than double their length. They are bent inwards on the hinder surface, and are somewhat more transparent in the middle part, showing thereby that they originally consist of two lateral halves.

But it is more especially in the number and course of the *nervous stems* proceeding from this central chain of ganglia that *A. coregoni* differs from *A. foliaceus,* at least according to the exposition of the nervous system of this latter species given by Leydig*. In *A. foliaceus* the ventral cord is similarly composed of six ganglia, but, strangely enough, no nerve-stems proceed from the *second, fourth,* and *fifth* of these. The *first* and *third* each give off *one* pair of nerves, the *sixth three* pairs, of which the innermost (last) passes into the head-shield, the others branching off to the second pair of footjaws and the legs. With *A. coregoni,* however, the case is quite different. The *first* ganglion gives off on either side *one* strong stem (as in *A. foliaceus,* where this stem gives off one branch to the sucking-cups, another to the second pair of footjaws); from each of all the following ganglia proceed *two* pairs of nerves; and these nerves unite with *two bundles* extending, one on each side of the trunk, as far as the tail. The further course of the various nervous stems I have not been fortunate enough to make out clearly: whether some of them branch forward or become fused together (as in *A. foliaceus*) I cannot venture to determine; for I entertain doubts on

* Ueber *Arg. fol.* p. 329.

this point. That one of the anterior pairs of nerves runs into the second pair of footjaws, that, moreover, out of the lateral bundles a nerve proceeds to each leg, and that the last (innermost) pair of nerves passes unbranching to the tail, I have, however, ascertained. No doubt certain stems proceed to the head-shield, although I have not been able to follow them thither. Of the two pairs of nerves which radiate from each of the second to the fifth ganglia, the foremost, which is also the thickest, proceeds from the margin of the ganglion, the hinder one from its underside. The nerves of the sixth ganglion are almost equally strong; those of one pair start from its side, those of the other from its hinder margin.

The *eyes* seem to be entirely similar in structure to those of *A. foliaceus.* The number of crystalline cones I have found to vary between 40 and 50. The single *eye-spot* consists of pigment only, without crystalline bodies.

The intestinal canal.—The narrow, chitinous gullet proceeds in a bowed shape to the stomach, where it opens, by means of a cup-like organ, into a *cardia,* which, however, is longer and narrower than in *A. foliaceus.* The length of this organ is about 0·33, its greatest breadth 0·15, and its least breadth 0·09 millim. The mouth of this organ is thickly set with papillæ or obtuse teeth. Before its entrance into this latter the gullet shows an increase of width (its greatest diameter being about 0·06 millim., its diameter where it enters the cardia about 0·04 millim.). The stomach itself is a short, spacious, posteriorly rounded sac, which passes into the intestine between the first two pairs of swimming-feet, being, however, distinctly separated therefrom. On either side the stomach sends forth a strong branch into the head-shield; the further outbranchings of this are not easily followed in a specimen in spirits; and therefore I cannot venture to state whether such branches are directed outwards only, as in *A. foliaceus,* or whether, as in *A. purpureus,* they proceed from the larger stems inwards as well as outwards.

The *intestine* extends as a spacious, gradually tapering tube from the stomachal sac to the anal opening, which is situated between the appendages of the tail.

The *heart* or dorsal vessel I have not been able to separate distinctly. I regard the tail as a *respiratory organ* which, on its inner surface, shows a copious network of muscular fibres, the contractions of which keep the nourishing fluid in quick and powerful motion.

Generative organs.—In full-grown females the ovary forms an oval mass, which extends from the base of the second pair of footjaws to the base of the tail, where the opening is situated in a low rounded projection. The surrounding membrane stretches

along the middle line of the upper surface of the adult animal, and is marked on either side of this median line with large dark spots, arranged in rows. In the sac which is formed by this membrane the eggs are closely packed together, sometimes rather firmly attached to each other, sometimes apparently quite free. They surround here a smaller, almost cylindrical organ (the true ovarium), to which the innermost eggs are firmly attached. I have sometimes found that this organ contained a large number of eggs in a very early stage of development, while those lying outside were fully matured. I conjecture that these, after they are laid and sufficiently matured, become severed from the spot where they were formed, and so come to be immediately enclosed in the outer membrane of the ovary. Thus Leydig's suggestion that the ovaries in *A. foliaceus* are "a simple bag" does not apply to *A. coregoni.*

The number of the matured eggs is very variable. In a large specimen I have reckoned about 350 points. In appearance they are exactly like the eggs of *A. foliaceus.* Their length is about $\frac{1}{2}$, their breadth about $\frac{1}{3}$ millim. The receptacula seminis are situated, as in *A. foliaceus*, at the base of the tail. They have the form of an almost spherical bladder, from which a long channel of communication, with thick walls and a very narrow passage, proceeds to a conical papilla situated in a concavity on the side and somewhat behind the mouth of the ovary. In this passage, rather nearer to the papilla than to the receptacle, is the commencement or opening of another blind, crooked canal, spiral towards the end: in *A. foliaceus* two such canals are found. The receptacle itself is, in young specimens, perfectly empty, but in the older ones it contains another bladder, of a darker colour. Such is the case also in *A. foliaceus*, where, according to Leydig, this inner bladder first shows itself after pairing, and is full of spermatozoids. It seems to be perfectly closed, and may easily be taken out of the receptacle without breaking. Leydig asserts that its membrane is produced in *A. foliaceus* into a homogeneous thread, which stretches through the channel as far as the tip of the papilla. I have not found such a thread in *A. coregoni.* The passage of this channel of communication presents just the same optical appearance in individuals with or without the spermatozoid-bladder already mentioned; and the passage of the accessory canal is perfectly like that of this channel. If such a thread as that which Leydig speaks of were present here, it would certainly produce a streak in the canal. Moreover, when the bladder is taken out, a portion of the thread would follow if such were really present; this, however, does not occur, and I have been equally unable to detect it by cutting asunder the channel of the receptacle.

The two testicles are small, ovate, and extend some distance beneath each of the tail-lobes. The seminal vesicle in the posterior part of the trunk is oblong ovate, and sends forth on either side a capacious backwardly directed ductus deferens, which opens at the extremity of the trunk. The accessory glands, which no doubt exist, I have not been able to discover. Of the external organs of generation, which are much more complicated than in *A. foliaceus*, I have already given an account.

The species of *Argulus* which we have just described was first found in the lakes of Jemtland by Dr. C. L. Nyström, on both the *Coregonus* and the Grayling. The species of *Coregonus* which is most generally met with there is *C. lavaretus*, Linn.; and, according to the verbal communications I have received, it is on this species that *A. coregoni* was found, although it undoubtedly affects other species of that genus. Mag. H. Widegren has found and sent me several specimens from salmon-lakes in Dalsland, taken also from *Coregonus lavaretus*, and has asserted, moreover, that it occurs on *Salmo trutta* in the Vettern. The species is probably widely spread over Scandinavia.

In Dr. Nyström's already cited "Observations on the River-fauna of Jemtland," on p. 19, are the following remarks with reference to *Argulus coregoni*:—One of the parasites of the Gwyniad is remarkable from the fact of its giving a preference to a particular fish. An unusually large species of *Argulus* fastens itself at certain times in summer, in large numbers, on the Gwyniad, and also, though less readily, on the Grayling. Almost every fish has, during this time, one or several of these blood-suckers on its body, which bite it till the belly is quite drained of the blood. The fishes then hurry in crowds to certain parts of the lake where probably the currents are colder, and fall in large quantities into the nets which are there spread for them. This fishery lasts but a short time, perhaps two days only, but produces during that time in some localities several tons of fish.

[To be continued.]

XXVII.—*Notulæ Lichenologicæ.* No. IX.
By the Rev. W. A. Leighton, B.A., F.L.S.

Dr. Nylander, with his usual skill and sagacity, has recently discovered two new chemical tests or criteria which are likely to prove of great value in the study of Lichens, not only in the discrimination of many difficult and closely allied species, but also in associating varieties with their proper species, and in some instances in defining the affinities of genera. These tests are applied to the thallus; and their usefulness is at once demon-

strated and enhanced by the fact that the very smallest frustule is sufficient to determine the lichen submitted to them, and that whether in the sterile or fertile state, and even in the youngest condition. They are the hypochlorite of lime and the hydrate of potash; and the details of their reaction will be found in the 'Flora' of May 12 and 13, 1866, and more at large in an elaborate paper in the Journal of the Linnæan Society of London. The reactions take place in a powder or colorable material which is generated in the gonidial stratum of the thallus. In the *Roccellæ,* which are destitute of a cortical layer, the reaction is at once visible; but in the *Parmeliæ* and all other lichens which possess a cortical layer it is necessary to scrape off that organ, and to expose the subjacent medulla, in which the reaction takes place; and this is perfectly visible to the naked eye, and requires no aid of the microscope. Dr. Nylander attributes the red reaction of the hypochlorite of lime to the presence of "*erythric acid*;" and its operation is beautifully exhibited in *Combea mollusca, Roccella Montagnei* (soredia not coloured), *R. Sinensis, R. tinctoria, R. phycopsis* (soredia not coloured), in the *Dirinæ* (proving their affinity with *Roccella*), and in the *Urceolariæ* of the group of *U. scruposa* and its allies. No reaction, however, can be detected in *Roccella fuciformis* (except in the soredia), *R. hypomecha, R. Gayana, R. intricata,* and *R. leucophæa.*

The red reaction of hypochlorite of lime is observable in the medulla of the following *Parmeliæ*—viz. *tiliacea, revoluta, carporhizans, olivetorum, osteoleuca, hypoleucites, polycarpa, Borreri*; whilst no reaction can be detected in *P. saxatilis, perlata, perforata, cervicornis, lævigata, sinuosa, latissima, reducens, tenuirimis, mutabilis, physcioides, livida, hypotropa, caperata, physodes, conspersa,* and *olivacea.*

The other reactive, hydrate of potash, is of practical importance in Lichens whose natural colour is yellow, orange, or red; and the reaction occurs in the powder generated on the surface of the thallus and the apothecia. The red or purple colour produced on the application of the reagent is due to the presence of "*chrysophanic acid,*" and it is visible in *Physcia parietina* and *lychnea,* in the species of the group of *Lecanora cerina,* in young *Physciæ* and *Placodia,* in the apothecia of the erythrocarpous *Cladoniæ,* in the apothecia of *Lecanora ventosa, hæmatomma, erythromma, Lecidea Domingensis, flavocrocea, chrysosticta, leucoxantha, cinnabarina, russula,* &c. On the contrary, no red reaction is observable in *Lecanora candellaria* and *vitellina,* or in *chrysophthalma, epanora, Schleicheri, chlorophana, oreina, Dermatiscum, Lecidea lucida, geographica, Thelocarpon,* &c.

The hydrate of potash manifests also the presence of "*usneic*" and "*lecanoric acids*" by producing a yellow colour on the

thallus. Thus *Lecanora subfusca,* which exhibits the yellow reaction, is distinguishable at once from *L. umbrina, dispersa,* and *conferta,* in which no such reaction is visible.

The same reactive operates on other Lichens by producing a yellow colour which quickly changes into a red or purple. Of this a good example is *Lecanora cinerea,* which is thus distinguished from *gibbosa* (and its varieties *calcarea, lacustris,* &c.), in which there is no reaction. The *L. cinereo-rufescens,* Anzi, Langob. 73, has the same reaction as *cinerea,* proving it to be only a variety of that species, whilst the true *cinereo-rufescens* (and its forms *diamarta* and *obscurata*) has no reaction. The reaction takes place also in *Lecanora oculata, blanda, ochroidea,* whilst there is none in *L. mutabilis* and *verrucosa.*

To the above many other instances might be added; but these will be sufficient to show the applicability of these valuable tests.

XXVIII.—*On two new Species of Freshwater Polyzoa.* By E. Parfitt, Esq.

[Plate XII.]

To the Editors of the Annals and Magazine of Natural History.

Gentlemen,

I have much pleasure in introducing to your notice two new species of freshwater Polyzoa met with by me in my investigations of the Devonshire fauna, in the compilation of which in a catalogue form, with notes and observations, I have been engaged for nearly two years; and I hope by-and-by to publish it. The tracings enclosed are made from my own drawings taken from the life, which I hope your artist will be able to use.

As an appendix to Prof. Allman's beautiful monograph of the Freshwater Polyzoa, I beg leave to add the description of the statoblasts of *Paludicella Ehrenbergii,* as they had not been seen by the learned author, and I have been fortunate enough to meet with several:—

The outline is a very elongated ellipse, the cell very small as compared with the very broad border, plano-convex; the cell reddish brown, the annulus or border bluish purple, beautifully reticulated and reflecting the prismatic colours.

They were arranged three in each tube, placed end to end.

I have met with a variety of *Paludicella* which I shall have something to say about at some future time.

I am, Gentlemen,
Yours obediently,
Edward Parfitt.

Exeter, Aug. 3, 1866.

Plumatella lineata, n. sp. Pl. XII. figs. 1–3.

Cœnœcium creeping, adherent, somewhat radiating, reddish horn-colour, cylindrical, with eight or ten dark-brown longitudinal lines running the whole length of the tubes.

Polype-cells barrel-shaped, hyaline, the mouth entire, each having five or six distinct dark-brown annulations, slightly constricted at each annulus.

The orifices or polype-cells frequently produced in pairs.

Animal white, or with a faint tinge of yellow, having the longest tentacles of any species I have seen.

Calyx none? Tentacles sixty-two.

Statoblasts dark reddish brown, elliptical, with a broad yellow margin.

Habitat. On the underside of the leaves of water-lilies in a pond in Mr. Veitch's old Nursery, Topsham Road, Exeter, July 1866.

In habit this species is like that described by Van Beneden and named by Prof. Allman *P. stricta*. The form of the statoblast is the same, but the description appended to that species is so brief that I cannot pronounce the one under consideration and *P. stricta* to be the same. Nothing is said of the peculiar lineated appearance of the tubes as seen in this, which to me marks it at once as distinct; and the peculiar dark annulations on the polype-cells form another good distinction.

The animal is the largest and I may say the grandest of all the species that have come under my notice, either in reading or seeing the animals themselves; its name ought to be *Pluma*, without the diminutive termination. They have a peculiarity of half withdrawing themselves within their cells, so that their long flexible tentacles alone protrude; these are then made to sweep the water, waving to and fro something like the Terebellas in the sea.

Plumatella Limnas, n. sp. Pl. XII. figs. 4–8.

Cœnœcium adherent, branched, the branches growing mostly in pairs, and slightly enlarged towards the orifices, which are somewhat conical, not occupying the extreme end of the tubes, transparent, entire, and raised above the tubes, with three or four folds or rings towards the base. The whole upper half of the tubes or polypidom transparent, hyaline, showing under condensed light a very faint line of dusky granules running the whole length of the tubes. The inferior half of the tubes opake and coated with grains of reddish-brown matter; these opake walls are white inside the tube, and are made up of pentagonal cells, the walls of which are very thick in comparison with the size of the area of the cells.

Animal white; tentacula fifty to fifty-four. Calyx festooned. Statoblasts elliptical, yellow, with a narrow blackish ring dividing the cell from the narrow purple rim or annulus which surrounds it. The cell is beautifully reticulated externally. Two out of the three statoblasts observed had a slight constriction on one side, which gave them a slightly reniform outline.

Habitat. On an old valve of *Anodon cygneus*, in the canal, Exeter, June 23, 1866.

This appears to be a very distinct species, and is allied or, rather, belongs to that section of the genus to which *P. emarginata* belongs, viz. with a line or ridge along the upper part of the diaphanous tube. But the line of demarcation between the diaphanous portion of the tube in this species and the thick opake walls of the inferior half gives it, even at first sight, a very distinct and marked appearance. Another striking peculiarity is that the tubes grow mostly in pairs, and are very closely adherent to the matrix, except the polype-cell, which stands up conspicuously near the end of the tube.

Length of the cœnœcium 10 lines.

EXPLANATION OF PLATE XII.

Fig. 1. *Plumatella lineata*: cœnœcium, nat. size, or 2 inches in its longest diameter.
Fig. 2. A portion of the same, enlarged, showing the animals protruded, and one partly withdrawn within its cell.
Fig. 3. Statoblast.
Fig. 4. *Plumatella Limnas*: cœnœcium, enlarged.
Fig. 5. Polype-cell, showing its position at the end of the tube.
Fig. 6. Showing the true polype-cell within the ectocyst.
Fig. 7. The polype expanded.
Fig. 8. Statoblast.

XXIX.—*On the Classification of* Buprestidæ *and* Elateridæ, *with special regard to the Danish Fauna.* By Prof. J. C. Schiödte*.

I.

By the well-known and valuable researches of Eschscholtz (published in Thon's 'Entomologisches Archiv,' ii., and in Silbermann's 'Revue Entomologique,' vol. iv.) attention was drawn to a great number of hitherto unobserved points in the external structure of Elateridæ, on which he founded an artificial classification of that family; and since then, the remainder of Latreille's *Sternoxi* have been subjected by other entomologists to an analogous examination, resulting in the establishment of more than

* Translated from 'Naturhistorisk Tidsskrift,' ser. 3. vol. iii. Copenhagen, 1865. Accompanied in the original with a plate representing the organs of the mouth.

300 genera. The usefulness of this work in procuring at any rate a temporary survey of the extensive collections which have accumulated in museums cannot, of course, be doubted; but at the same time it is but too apparent that this method is entirely insufficient whenever it is attempted by its means to establish and satisfactorily circumscribe natural groups. Not even for the distinction of the two great natural families of Buprestidæ and Elateridæ have truly scientific characters been forthcoming; it has been found necessary to adopt a number of unsatisfactorily characterized groups, forming, as is supposed, links of transition between them; and the characters which at length have been fixed upon as the most distinctive and most generally valid are, as will be shown hereafter, unstable both in theory and practice, and unable to stand the test either of morphological criticism or of careful examination. Two excellent entomologists have engaged in the study of Elateridæ, in order to bring about a more natural view of the relationships; I mean Germar and Erichson: but, as Lacordaire observes, both have evidently given it up in despair; and the last-named author himself, after long-continued and careful investigations, cannot suggest any other remedy than, as he expresses himself (Genera des Coléopt. iv. p. 137), "to let tradition make up for the inability of science to master the subject."

Lacordaire's summary of the earlier investigations, and his general view of the structure, development, and habits of *Sternoxi*, reappears, in all essential points, together with many valuable contributions of detail, in the extensive and independent treatises on these families which have appeared during the last few years from the hands of Leconte*, Kiesenwetter†, Thomson‡, and Candèze§. In this manner certain views concerning the principal points in the natural history of these animals have been temporarily established by the repeated examination and assent of the greatest modern authorities in this department.

II.

If we attempt to extract from all these sources the essence of the information they offer concerning the larvæ of Buprestidæ and Elateridæ, the result may be thus summed up.

The larvæ of Buprestidæ are soft, elongated, blind, apod, and live burrowing in timber. Their prothorax is discoid, laterally distended, their head divided into two parts, of which the smaller

* Classification of the Coleoptera of North America, Part 1. Washington, 1861–1862.

† Naturgeschichte der Insecten Deutschlands, iv. Berlin, 1858.

‡ Skandinaviens Coleoptera, synoptiskt bearbetade, vi. Lund, 1864.

§ Monographie des Elatérides. Liège, 1857, &c.

anterior part carrying the organs of the mouth is chitinized, whilst the larger posterior part containing the mandibular muscles is soft and retractile within the prothorax. In some, however, as in the larvæ of *Diphucrania* (New Holland), the prothorax is not distended; and the larvæ of *Trachys*, which live in the parenchyma of leaves, where they excavate their burrows, are said to have hard dorsal and ventral shields, free head, two eyes, and short legs.

Similar to the larvæ of Buprestidæ are those of Eucnemidæ. The larva of *Melasis* is only distinguished by the structure of the mouth, and by the head consisting of one piece only. The mandibles are not chisel-shaped, as in the larvæ of Buprestidæ, but short, turned outwards, with a hook on their external margin, close behind the point; and the other buccal organs, which are free in the larvæ of Buprestidæ, are in that of *Melasis* represented by a small plate serrated in front. It is said to live in fresh timber, forming long irregular galleries, with entirely smooth and even walls, a piece of the burrow being rounded off in the shape of a cylinder for the accommodation of the pupa. At the same time, exceptions occur in the group of Eucnemidæ as in that of Buprestidæ, the larva of *Fornax madagascariensis* being, according to Coquerel, flat, depressed, and hard, the prothorax not distended, the head hard, flattened in front, with a serrated edge, without perceptible organs of the mouth—nay, without a buccal orifice; the larva burrows in timber, as that of *Melasis*.

Entirely different from these are the larvæ of Elateridæ. They are long, slender, with a hard skin, cylindrical or a little depressed; the mandibles are hooked and pointed, with an interior tooth; the maxillary lobes and palpi are distinct, the maxillæ coalesced with the labium into one piece; the legs are short and powerful, and the last joint of the body often furnished with prominent teeth. They are supposed to live on vegetable matter, many on decaying timber; sometimes, however, they feed on the other larvæ they happen to fall in with. For more than a century the larvæ of *Agriotes* have been known as dangerous enemies of several cereals, leguminous and other agricultural plants, of which they attack the roots.

Such is a summary of what science hitherto has taught us as to the history of these larvæ; but it is quite clear that these statements do not afford the materials for an accurate estimation of the systematic relationships of these creatures. Nay, these statements even contain several details which, on closer examination, cannot but excite doubt and suspicion, and stimulate to new investigations.

This applies, in the first instance, to the statement that in the larvæ of Buprestidæ the mandibular muscles are not, as usual,

fixed to the firm sides of the head, but pushed back into a peculiar kind of soft bag behind the head. If anybody were to state that he knew of a group of Rodentia whose jaw-muscles were not fixed to the sides of the skull, but accommodated in a membranaceous appendage behind the occiput, the absurdity would be apparent to every one; but that statement concerning the mandibular muscles of the larvæ of Buprestidæ implies a difficulty if possible still greater. For as their hard mandibles are articulated on the firm framework of the mouth by means of complete cardinal joints, the necessity for a firm support for the moving muscles is still greater than in Rodentia. The difficulty is, moreover, enhanced by the fact that the membranaceous part of the head with the mandibular muscles, when compared with the smaller anterior part containing the organs of the mouth, in shape and size appears as a larger circle placed behind a smaller one, from which it follows that the relative position of the base of each mandibular muscle and the inner angle of the mandible, or the point on which the tendon must join the mandible, must be such that a muscle thus placed could not inflect the mandibles unless the tendon went through a pulley. But such a pulley-arrangement would seem inapplicable where so great a force is required as is the case with chisel-shaped instruments destined in many cases to be used as pincers to detach piece after piece of sound timber.

This account, which it seems so difficult to reconcile with general truths, is mainly due to Prof. Erichson (in Archiv für Naturgeschichte, 1841, i. p. 81), and it has met with universal assent as the only true solution of the problem (which is certainly not very easy) how to interpret the peculiar-looking front part of the body of the larva of Buprestidæ. Before him Löw had turned attention to the matter, asserting (in Entomologische Zeitung Stettin, 1841, p. 35) that the larvæ of *Chalcophora*, "as those of all Buprestidæ, are distinguished by the extension of the prothorax, which is rendered necessary for the reception of the enormous mandibular muscles." Löw, therefore, agreed with Ratzeburg in assuming that not the head, but the prothorax, was divided into two parts, of which the anterior part was soft, the posterior endowed with hard skin. Against Löw, Erichson urged the great anomaly of the mandibular muscles being placed in the prothorax; and it seems that this consideration more than any other has led him to the new interpretation which is now generally adopted; for in favour of this he appealed to the fact that the muscles in question did not, as Löw thought, fill the whole prothorax, but only its anterior soft portion, which he therefore considers to be part of the head, while he considers that part of the body which Ratzeburg and Löw looked upon as

the whole head to be merely a firm framework for the mouth. The correctness of this view is generally assumed. Chapuis and Candèze concur in it entirely, and even try to support it by an additional argument, which I cannot but think is of very doubtful value—namely, that the head must have soft integuments for the purpose of being retracted into the prothorax*. On the subject of Goureau's theory†, according to which the whole of the prothorax becomes head, Lacordaire observes that it does not deserve refutation, that moreover it has been sufficiently refuted by Léon Dufour and Perris; he considers Erichson's interpretation so decidedly true that he looks upon that of Ratzeburg and Löw as an almost inexplicable error (Genera des Coléopt. iv. 7. 1).

Nevertheless Erichson's theory offers, as we have seen, insuperable difficulties in a physiological point of view; and it seems to be quite worth our while to try whether the matter may not be differently regarded. Let us, then, first of all try to realize fully the conditions under which the larvæ have to exist in the interior of the timber, and compare the structure of other larvæ burrowing in wood, particularly the apod larvæ of Cerambycidæ; we shall then soon arrive at two important conclusions. In the first place, the mandibles must possess extremely powerful flexors, which consequently must be too large to find room in the proportionally small part which has hitherto been looked upon as forming the whole head in the larvæ of Lamiæ and Buprestidæ; in the second place, the great demands upon the power and endurance of these apod larvæ cannot be satisfied by the strength of the mandibular muscles alone, however great; but power and accuracy in the guidance of the head—that is, in the application and pressing of the mouth against the timber during the act of burrowing—is required in no less degree. In these sentences lies the key of the whole complicated arrangement. A careful dissection will show, what is sufficiently surprising, that no one has hitherto had an accurate idea of the real extent, shape, and position of the head in the larva of either Lamiæ or Buprestidæ. The fact is, that the protruding anterior part of the head is uninterruptedly continued backwards into a very large skull, which, in the larvæ of Buprestidæ, is so large that it actually reaches the very bottom of the prothorax, so that the neck is on a line with the first pair of

* "En effet, dans ces larves la plaque sous-céphalique, cornée à sa partie antérieure, est devenue très-molle dans le reste de son étendue, parce qu'elle doit se replier sur elle même pour rentrer avec les parties de la bouche dans la gaîne que lui forme le prothorax." (Chapuis et Candèze, Catal. des Larves de Coléopt. pp. 131, 132.)

† Ann. de la Soc. Ent. de Fr. sér. 2. vol. i. p. 26.

spiracles. With the exception of the middle line, this large head will be found filled by the powerful flexors of the mandibles, reaching to the foramen occipitale, which is very large and entirely transferred to the under surface of the head. The head, then, is for the greater part hidden in the prothorax as in a sheath, fixed all around and directed by the powerful muscles of the neck. The whole of the part which is placed inside the prothorax is only sparingly chitinized; but the action of the muscles of the neck extending between the outside of the skull and the walls of the prothorax makes up for any loss of support which could arise to the mandibular muscles from the want of hardness in the skull. During the act of burrowing, the prothorax is firmly ensconced between the walls of the gallery, the numerous grains of chitine with which its surface above and below is generally beset increasing the firmness of its position; and thus every requisite condition is provided—a firmly placed prothorax affording support for the muscles of the neck in guiding the head forwards and backwards and to the sides, and the skull inserted as in a sheath giving support to the enormous mandibular muscles.

The immense size of the head and its deep insertion into the prothorax, of course, are the causes of the peculiar shape and unusual size of the latter part, which has further contributed to confound the views of entomologists on the structure of the larvæ of Buprestidæ*. It has been overlooked by all that in this case one part of the prothorax is developed at the cost of the others—namely its anterior portion, the so-called collar (collare prothoracis), which is found in all larvæ and all imagos of insects with more or less inserted neck, but which in the larvæ now before us is immensely increased in size. In my paper on the larvæ of Coleoptera, published in the 'Naturhistorisk Tidsskrift,' I describe the dorsal part of this collar as prætergum pronoti. The rest of the prothorax, which is elsewhere much the larger, and which serves the locomotory system by accommodating the fore legs, is in this case to such a degree reduced that it seems to be entirely wanting, and the large spiracula thoracica have not been able to find room as usual on the prothorax, but have been transferred to the lateral folds of the next ring, pleuræ mesothoracis. The larvæ of *Trachys* being described as possessing a free head and short legs, it will, no doubt, be found that the larvæ of Buprestidæ will show the same

* In the Mém. de l'Acad. des Sc. de Lyon, 1851, pp. 116–120, M. Perris has given a minute summary of the discussion between Goureau, Lucas, and Léon Dufour on this subject. Although each of the four authors now and then has got hold of the clue for a moment, they have always lost it again, and none of them has succeeded in solving the problem.

series of forms as those of Cerambycidæ, but in a less degree. In these latter the collar of the prothorax varies not a little in extent according to groups and genera, the head being in some cases deeply inserted into the prothorax, in others tolerably free; but, in all of them, so much at least of the principal portion of the prothorax remains that, at any rate on the underside, it appears as a transverse fold which carries the short legs when such are found. To the larvæ of Lamiæ correspond those of Buprestidæ, to that of *Trachys* the larvæ of Lepturini, in which the head is sometimes so little inserted that it seems to betray a relationship to those larvæ of Curculiones which burrow in timber. When the head occupies such a position as in the larvæ of Buprestidæ, being inserted in the prothorax, the skin of the neck must necessarily be very full, in order to afford the necessary play for the protrusion and retraction of the head; and in proportion as the insertion of the head is deeper, the skin of the neck is fuller and more protruding.

It will now appear that although none of the theories above mentioned have hit upon the facts, they all contain in some way an element of truth. Löw's view is purely anatomical, and although wrong in a morphological sense (because the mandibular muscles cannot well be situated in the prothorax of any insect with articulating mandibles), yet it is so far true that the head which contains them is itself imbedded in the prothorax; what Löw has overlooked is the walls of the head. Goureau's view is, so to say, that of common sense unshackled by anatomical or morphological scruples; and from such a point of view the prothorax might be called the head with perfect justice. Erichson's view is learned and critical, with a theoretical element inviting attention, but is neither probable in a physiological point of view nor true in point of anatomy; it has therefore less of body or soul than either of those it attempts to reconcile. What he considers the hind part of the head is merely the distended skin of the neck.

III.

The striking external similarity between the larvæ of *Melasis* and those of the Buprestidæ has not only served as a principal argument for looking upon *Melasis* as a connecting link between Elateridæ and Buprestidæ, and thus exercised a decisive influence on all the more recent attempts at a new classification of the Sternoxi, but it has at the same time weighed heavily against the probability of finding in the study of the larvæ a sure guide to the true classification of insects—a circumstance which Erichson has not omitted to mention in the introduction to his instructive treatise on the larvæ of Coleoptera (in Archiv f. Natur-

geschichte, 1841, i. p. 62). He admits that very much will be gained for the classification of insects by a more accurate knowledge of their earlier stages; but at the same time he warns us against entertaining too high expectations as if the progress of classification principally depended on the study of the metamorphoses, and he urges particularly that we must not suppose that a classification according to the larvæ would always coincide with a classification according to imagos. He mentions by way of illustration that one would naturally expect a great similarity between the larvæ of Buprestidæ and those of Elateridæ, which does not really exist, and that the larva of *Melasis* would make a nearer approach to the *Elater*-type than to the *Buprestis*-type, whereas the reverse is rather the case. A couple of pages further on he sums up his remarks in this general result—that, although it would not be possible to build a classification on the structure of the larvæ, it will nevertheless be of the greatest importance, nay, decidedly necessary, to take that point into consideration, as it will always do good service as a means of testing classifications founded on other principles,—a general statement which I have no doubt sounds so very qualified principally because he was checked by the idea that Buprestidæ and Elateridæ are very nearly allied to one another, though their larvæ are so different, and by the apparently anomalous relations of the larva of *Melasis*. But for these points being present to his mind, his verdict would have been much fuller and more decided. These words, like so many others which have proceeded from the celebrated entomologist—too early taken away from his bright scientific career—have awakened an echo in many a dark corner, and since served as a principal support for the often repeated and convenient assertion that the earlier stages of insects correspond in many cases so little to the relationships of the imagos, that they even at times vary more according to species than generally according to genera or families. And thus it has come about that this view of the larva of *Melasis* now stands as a sort of barrier in front of an immense tract of scientific fallow land, which only by the razing of that barrier can be made available for new culture.

And this barrier indeed seems indestructible; for how could anybody presume to doubt that the larva of *Melasis*, which presents such a striking external similarity to the typical larva of *Buprestes*, also burrows in timber like the latter, seeing that we possess minute accounts of it by such able entomologists as Nördlinger* and Perris†, the former of these having, as well as Guérin‡, even supplied us with drawings of its burrows, galle-

* Stettin. entom. Zeit. (1848) pp. 225–226, t. 1. fig. 2.

† Ann. de la Soc. Entom. de Fr. sér. 2. v. 548. ‡ *Ibid.* i. pl. 5. fig. 4.

ries, and beds for the pupa excavated in the solid timber? At first sight an attack seems hopeless on so strong a scientific fortress; but a closer inspection will, I trust, discover more than one weak point.

The structure of the larvæ of Buprestidæ is easily understood, for in every point it exhibits with great consistency the peculiar characteristics of an animal burrowing in wood. Such are the large head deeply seated in the prothorax, the short thick mandibles formed like a hollow chisel, the large protruding labrum, the short, freely developed lower organs of the mouth, the powerful muscles of the neck, the broad prothorax beset with grains of chitine, the slender body adapted for creeping through galleries, the large anal segment, which is turned straight backwards. If now the habits of the larva of *Melasis* are really the same as those of the larva of Buprestidæ, its structure must be identical with theirs at least in these principal points. But if the similarity only applies to the external structure, it is clearly insufficient, however striking, to prove a true *affinity* between these creatures, or even a similar way of feeding; it merely justifies us in supposing that they live in similar localities and use a similar mode of locomotion. One would think that such a conclusion, of which the truth is evident to common sense at every step in the study of living creatures, could not but be sufficiently appreciated and generally adopted. Nevertheless, as I have often urged on other occasions, no principle is oftener sinned against. No source of errors in natural history flows more copiously than that which rises from the confusion of relationship with similarity, of affinity with analogy, of typical characteristics with biological modification; so that it is but too clear that we have as yet advanced but very little towards the great aim of comprehending the rational consistency of nature. It is this ancient, ever recurring mistake which also in this case has obscured the truth.

For in spite of the positive and decisive appearance of the investigations just alluded to, they nevertheless embody a simple impossibility. Instead of a rasp-like chitinous armour on the prothorax, the larva of *Melasis* has merely a couple of narrow, partly transversely grooved bands of chitine, and its skin is generally thin and weak; the lower organs of the mouth are rudimentary, and coalesce into a small plate; the labrum is absent; the mandibles are pointed and bent *outwards*, they have a tooth *on their back*, and their inner margin presents merely a narrow unarmed edge; the head is free, rather soft, with only a few firmer bands of chitine forming a framework round the epistoma and hypostoma; the anal or tenth abdominal segment, which in the larva of Buprestidæ forms a direct continuation of the body, appears here merely as a small

protuberance on the ventral surface of the ninth segment; this latter exhibits exactly the same serrated margin as in the larva of Elateridæ—a circumstance which has hitherto been entirely overlooked, perhaps because it is very little chitinized in *Melasis*; and, finally, the larva of *Melasis* has no buccal cavity at all, but only a very small opening for the mouth, so small that it can only be observed with difficulty—a point hitherto overlooked, but of the greatest importance.

As soon as these facts are fully appreciated and properly combined, every idea of an animal so constructed burrowing in timber and feeding on it must at once be relinquished; and if we then examine the accounts before us, it will soon appear that the investigators have not really seen what they and others think they have seen.

Guérin had the larva and the piece of wood he figures sent to him from the Vicomte de Lamotte-Baracé, and he therefore founds his statements entirely on the written account of an unscientific correspondent.

Professor Nördlinger found the beetle sitting on an alder branch 3 inches in diameter and perforated with galleries in all directions. He asserts that "the deposition of the eggs certainly takes place in the same way as in Buprestidæ, the mother beetle therein making use of clefts in the bark or even in the timber;" but as he does not say that he really has observed the process, his assertion, in spite of its decided language, cannot be looked upon as anything more than a mere supposition. He states, on the other hand, that he did find a dead beetle with its head and body half hidden in a "fly-hole"—that is, one of the openings made by perfect insects on making their escape, at the end of their transformation, from the timber on which they lived as larvæ; but he surmises that it only intended to hide itself there; for he says, if the beetle had penetrated into the timber through old burrows and deposited its eggs in the galleries, he thinks that he must have met with beetles in such burrows, which he has not. He adds, however, one observation which admits of no other explanation than that the eggs had *not* been deposited from the outside on the bark, but, on the contrary, in a burrow inside the wood—namely, that he found quite young larvæ in the thick of the timber, several inches from the bark. From a log of wood taken in one year, in November, beetles made their appearance through several consecutive years, from which he considers that the larva takes at least three years to complete its development. The larva is found in the burrows in a bent-up position, compressing the wood-dust behind itself so as to form an arched cavity. The burrows are undulating, but only in a horizontal plane*.

* Stettin. entomol. Zeit. (1848) p. 225–226.

According to Perris, this larva forms broad irregular galleries in the interior of the timber, at a depth of from 2 to 5 centimetres. The form of these galleries is, in his opinion, as characteristic as that of the larva itself, being different from the burrows of any of the many other timber-larvæ with which he is acquainted. He states that the walls are so smooth that they look as if they were produced by means of a very sharp instrument*; and as this is indeed the only remarkable peculiarity which he mentions in these burrows, it would appear as if he looked upon this smoothness and evenness as their great distinctive feature. But such are the burrows of a great many, if not all, timber-larvæ, when they are cleared of wood-dust, which, generally speaking, is indicative of their being *old* and long left by their original inhabitants. There is therefore nothing really characteristic in this; and I am inclined to think that Perris's expressions rather proceeded from some indistinct feeling that the appearance of the burrows did not quite agree with that of the larvæ (supposing the latter to have constructed them). For just before, speaking of the outward-bent hooked form of the mandibles, he says that he should have thought it a monstrosity if he had not found it in all the individuals he examined and thus convinced himself of its being of constant occurrence. He adds the observation that the larva moves its mandibles horizontally, like other larvæ, but that it gnaws the wood *not in closing them, but in opening them*†.

Here, then, we are placed face to face with the unheard-of phenomenon that the mandibles of an articulated animal bite and gnaw, not by being approached to one another, but by being separated, not by closing, but by opening, not by the action of their flexors, but by that of their extensors! We are called upon to believe that a larva not only makes way for itself through solid timber, but even constructs extensive burrows and galleries with extremely smooth walls, lying all the while quite loose curled up on its side without support, working in a desultory

* "Elle s'enfonce dans le bois à une profondeur de 2 à 5 centimètres, en creusant des galeries larges et irrégulières dont la forme est aussi caractéristique que celle de la larve même et comme n'en pratique aucune des nombreuses larves xylophages que je connais. Ce sont des cavités qui ont en largeur une fois et demi celle de la tête, et près de trois fois celle du corps et guère plus d'un millimètre de hauteur. Leurs parois sont si nettement taillées qu'on les dirait façonnées par un instrument très-tranchant." (Ann. de la Soc. Ent. de Fr. 2[e] sér. v. p. 545.)

† "Je crus la première fois, que c'était une erreur de la nature, une sorte de monstruosité, et si je n'avais vu qu'une seule larve, j'aurais certainement signalé avec quelque méfiance une semblable anomalie...... Le jeu de ces mandibules est horizontal comme dans les autres larves; mais c'est en s'écartant et non en se rapprochant qu'elles rongent le bois." (*L. c.* p. 543.)

manner, spreading out a pair of pointed hooks now in one direction and then in another!

Nevertheless it is but justice to these observers to say that, had they not gone to their task with their eyes blinded by prejudice, they would not have imagined they saw what they never really did see, nor have taken refuge in interpretations which they would otherwise have disdained; and their prejudice was, that similarity in outward appearance always entails similarity in habits of life. Whether the mother beetle deposits her eggs in the clefts of the bark, or, what is far more probable, penetrates through the openings of old burrows, and lays her eggs in old galleries, these latter are certainly not the work of the *Melasis*-larva.

The similarity in outward appearance between this larva and those of Buprestidæ means nothing more than that the former is destined to live in the burrows formed by the latter or by other similarly equipped xylophagous larvæ. What the larva of *Melasis* tears and perforates with its mandibles must be something soft, not a hard substance; in fact it cannot be anything else than the skin of really xylophagous larvæ and pupæ. Whatever be its food, it must take it in by drinking, and there is nothing for it to drink but blood.

IV.

A minute orifice of the mouth; pointed mandibles, placed at a distance from the mouth; no labrum; the lower organs of the mouth coalesced; short antennæ; slender body; the ninth abdominal segment serrated; the anal segment placed under the preceding; movement by lateral winding of the body: these were characteristics of the larva of *Melasis*, and these same characters are those of the larvæ of Elateridæ. Nor must we allow ourselves to doubt their affinity because the former is destitute of legs and of chitinous armour, or because the mandibles are bent outwards instead of inwards and the second and third pair of appendages of the mouth are rudimentary; to lay overmuch stress on these points would simply lead us through a byway back to the same confusion which has done so much mischief, and owing to which the *Melasis*-larva was thought more closely allied to the larvæ of Buprestidæ than to those of Elateridæ merely because it was apod and soft. The larva of *Melasis* does not in reality present a greater modification from the type of Buprestidæ than many of those which I have described in my Contributions to the Knowledge of the Larvæ of Coleoptera*—not more, for in-

* Naturhistorisk Tidsskrift, ser 3. vol. i. pp. 193–232, pl. 3–10; vol. iii. pp. 131–224, pl. 1–12.

stance, than the remarkable larva of *Haliplus*, which in so striking a manner maintains the type of its family, whilst so widely differing in external appearance. At the same time, perhaps, there is not much reason to fear such an objection just at present; for although it is still constantly repeated that the larvæ of Elateridæ are generally phytophagous, and only exceptionally take animal food, I do not hesitate to assert directly the contrary—namely, that they are carnivorous as a rule, and only exceptionally phytophagous; and the positive affirmation of this truth has, so to say, long been looming in the horizon. Erichson considers the larvæ of Elateridæ unreservedly as phytophagous, some being supposed to feed on decaying wood, others on fresh roots: nevertheless he was not without scruples, for he adds, in a note, that he doubts whether larvæ with such a mouth really can masticate their food (Archiv f. Naturgeschichte, 1841, i. pp. 87–88). Nor do I doubt that many a collector, when his attention is drawn to the subject, will remember very often to have met with these larvæ under bark, in decaying wood and wood-dust, engaged in the very act of piercing the bodies of soft larvæ and pupæ, and thus be enabled to confirm from his own experience those testimonies which already have appeared at different times as to the carnivorous habits of the larvæ of Elateridæ. It seems that the attention of some has already been drawn to the analogy between the structure of their mouth and that of the larvæ of Carabi; so that it may soon be generally acknowledged, what I certainly hold to be the true view, that they are as truly typical carnivorous animals as the larvæ of Carabi, and that they bite through the skin of their prey, tear it to pieces, crush and suck it just like the larvæ of Carabi—with which tribe they also correspond in this particular, that a certain number of them, being on purpose endowed with shorter and thicker mandibles, shorter legs, less perfect armour of the point of the abdomen and of the anal segment (that is, with less power of locomotion), eat their way into juicy and farinaceous roots, destroying them in the same way as the animal food of the majority is treated, by crushing and sucking. It is a state of things quite analogous to what we find in insectivorous and carnivorous mammalia, among which the hedgehog, the badger, and the bear are distinguished by modifications of the type, either in the movements of the jaws, or in the teeth, or in both, which do not by any means destroy the original carnivorous type, but nevertheless enable the animal to extend its range of food to vegetable matter sufficiently rich in nitrogen.

If, now, we comprise within our view the whole division of Sternoxi, starting from this new information we find that the

larvæ of that division group themselves round two, and only two, entirely different types—that of *Buprestis* and that of *Elater*, the former burrowing in different parts of plants and being phytophagous, the latter being blood-suckers or living on vegetable juices. In both divisions we meet with modifications of the type analogous to those met with in all other natural divisions of Coleoptera,—their body being more or less hard or quite soft, the buccal organs, the organs of movement, the limbs, the point of the abdomen and the anal segment more or less developed—all in accordance with the occurrence and quality of the food. The larva of *Melasis* thus belongs to the *Elater*-type, but is modified for the purpose of hunting xylophagous larvæ living in hard wood. In the larva of *Fornax* the mouth appears, from the description of Coquerel (Ann. de la Soc. Ent. de Fr. sér. 3. iv. pp. 511–516, pl. 15. fig. 3 *j, l, m*), to be still more modified than that of *Melasis* in the direction of the organization met with in such larvæ of Antliata as live on prey in galleries in wood, *i. e.* in those larvæ of *Laphria* which suck the larvæ of Buprestidæ.

These larvæ of Antliata correspond, within their own order, exactly to the larvæ of *Melasis* and *Fornax* in Coleoptera, the relation in point of structure between the former and the phytophagous larvæ of Antliata being exactly the same as that between the Coleopterous larvæ in question and those of Buprestidæ. That Coquerel failed to discover the opening of the mouth in the larva of *Fornax* can have been caused only by the fact that it merely possesses a small orifice for sucking blood, whereas he expected to find a large cavity of the mouth, supposing as he did that the larva burrowed in timber and fed on wood. Lacordaire, who also supposed that it "fed on wood" and constructed galleries, though only in decaying wood, is likewise astonished at the want of a mouth (Gen. des Coléopt. iv. p. 565).

I have on purpose limited the preceding inquiry into the larvæ of Buprestidæ and Elateridæ to what was absolutely necessary for the attainment of my aim, which was nothing more than to clear away the obstacles which that interpretation of their structure which has hitherto prevailed has placed in the way of that view of their mutual relationship which will be developed in the sequel. I am in possession of very rich materials for the illustration of these larvæ in detail; but I reserve that for the continuation of my papers on the larvæ of Coleoptera, published in the 'Naturhistorisk Tidsskrift.'

V.

For a long time after the publication of Audouin's well-known treatise on the thorax of Insects, in which he had distinguished

as a separate piece a small part of the skeleton situated near the root of the coxæ and called by him the *trochantin*, only very little attention was paid to it. The modern examinations of the external skeleton of insects, undertaken for the purpose of discovering useful marks of distinction for the numberless genera and other divisions established by entomologists according to a general impression of the habitus of the animals, have, however, in some cases led to the trochantins being taken into consideration; and they are said to exist in some cases, but to be wanting in others. This view, however, appears to be erroneous. They seem never to be wanting in Coleoptera (to which we are now particularly alluding), although they vary very much in size and shape; and the difference in question would be more correctly indicated by describing the trochantins as either covered by a prolongation of those plates of the skeleton which surround the coxæ, or uncovered and bare. At the same time, however, cases would occur in which it might be difficult to say whether the trochantins should be called covered or uncovered, as in some instances they are not visible till the coxæ are turned back in their sockets. Besides this, the definition of the family of Buprestidæ now generally adopted contains another still more misleading feature—that part of their thorax which has been called the trochantin being an entirely different piece and having nothing to do with the coxa. In one instance the common interpretation has been exchanged for a new one; but this new interpretation is not only erroneous in itself, but does not agree with a thorough understanding of the true structure of the prothorax in insects.

In Buprestidæ, as well as in Elateridæ, each of the anterior coxæ is on the outside surrounded partly by a receding prolongation of the prosternum, and partly by a portion of the lower edge of the epimeron. In the first group of the family of Elateridæ (see my classification below) these lateral laps of the prosternum are very short; but in the second group of Elateridæ and in Buprestidæ they are so long that they occupy about the same space as the epimera on the outer margin of the coxa. In all Elateridæ the laps of the prosternum and the epimera join so closely that the upper and outer part of the coxa, and with it the trochantin, are entirely hidden; whilst in Buprestidæ the parts in question do not join closely, whereby the socket of the coxa receives a small and narrow extension on the outside, and in this open groove a part of the coxa is always seen, whilst the little round trochantin itself is not seen, unless the coxa is turned back a little. It is therefore better to express the difference between these two families in this respect by drawing attention to the opening between the prosternum and epimera than by saying that the

trochantin is visible in Buprestidæ, hidden in Elateridæ. But if we say, as authors usually have said hitherto*, that only Buprestidæ possess trochantins, which are wanting in Elateridæ, then the real fact is entirely missed. And if other authors, as Lacordaire and Thomson, go further, and state that the trochantins are very large and prominent in Buprestidæ, and put this forward as one of their principal characters, then they must have overlooked the real trochantins, which are very far from being large or prominent, whilst the lateral prolongations of the prosternum just mentioned have been mistaken for trochantins. Nor is this mistake inexplicable; for the laps in question are in Buprestidæ separated from the rest of the prosternum by a more or less deep groove, whereby they assume the appearance of being connected with the coxæ. But any such belief is at once dispelled by turning the coxa about, in fresh or softened specimens, when it will be seen that the supposed trochantin remains quietly in its place, instead of following the movements of the coxa as a real trochantin would; and if the coxa is turned back in the socket, the real trochantin will appear in the open groove. To render the experiment still more convincing, detach the coxa from its socket, and the true trochantin will be found sitting in in its proper place, whilst the supposed trochantin shows itself to form one piece with the prosternum.

The only author who has refused to regard the lateral prolongations of the prosternum as trochantins is Von Kiesenwetter, who, without further explanation, describes them as episterna (Naturg. d. Insekten Deutsch. iv. p. 6). But, as already stated, this seems to imply another mistake. What we call epimera in the skeleton of Arthropoda are nothing but the chitinized side-folds (pleuræ) between the ventral and dorsal shields of the segments—that is to say, (in the thorax of insects) between the pro-, meso-, and metanotum above, and the pro-, meso-, and metasternum beneath. In many insects having the thorax strongly chitinized the epimera are found to be divided into two parts, of which the foremost is called the episternum, whilst the hindmost is then alone called the epimeron; but this division is owing merely to the necessity of procuring access for the air to the spiracles, which open behind the epimera. As, however, the articulation between the prothorax and mesothorax is so loose that the air can always easily penetrate into the spiracula prothoracica which are situated between them, there is no necessity for a division of the epimera prothoracica into episterna and epimera *sensu strictiori*; nor do we ever find such a division carried out,

* Lacordaire, Gen. des Coléop. iv. 1. pp. 90, 94, 130; Leconte, Classif. of the Coleopt. of N. Amer. i. pp. 156, 158, 159; Thomson, Skandinav. Coleopt. vi. pp. 6, 56.

although a slight indication of it may be found in some cases, where the posterior part of the epimeron is somewhat bent outwards. It is even very rare to find the pronotum and epimera prothoracica separated by a real suture (as in Carabidæ); nay, it often occurs that the sutures between the pronotum, prosternum, and the epimera become to such a degree effaced that the entire prothorax seems to consist of only one piece (as in most Curculionidæ). In Buprestidæ and Elateridæ all these parts are immoveably united, but the seams between the prosternum and epimera are always to be recognized, and the junction of the epimera and pronotum is marked by the more or less sharply raised lateral edges of the latter. It follows that the Buprestidæ possess no episterna on the prothorax, any more than any other insect, unless that appellation is to be given to the large lateral shields themselves which are commonly called epimera. Von Kiesenwetter regards the true epimera as laterally inflected parts of the pronotum, and gives the name of episterna to the prolongations of the prosternum (which other authors equally erroneously call trochantins), and thus he comes to the result that the prothorax in Buprestidæ consists of pronotum, episterna, and prosternum, but in Elateridæ of pronotum and prosternum alone (Nat. Ins. Deutl. iv. p. 217), whereas the prothorax in both families consists of the same pieces as in other insects, viz. pronotum, prosternum, and epimera prothoracica, as shown before.

VI.

Anybody who has watched nature a little in field and forest knows full well that faculty in the *Elateres* which has procured them the popular name of spring-beetles. It would therefore be natural to expect that the peculiar contrivance by means of which these beetles are enabled, when placed on their back, to toss themselves up in the air and fall down on their legs, had long ago been so thoroughly investigated and understood by scientific entomologists that it could always with certainty be decided whether any given species is endowed with this faculty or not. But this is very far from being the case: it is still a moot point with regard to many animals of the *Elater*-type whether they can spring or not, so that, generally speaking, one is not satisfied till one has seen the thing done before one's own eyes; and with regard to this mechanism there is but little agreement amongst entomologists, except concerning the cases where the articulation of the prothorax and mesothorax is sufficiently loose to allow us to inspect easily the whole structure and proceeding. This latter has been familiar for a very long time; and short and correct accounts of it are given in old manuals, as by Latreille in Cuvier's 'Règne Animal.' It is true that some

German naturalists (particularly Burmeister and Erichson), whose statements Lacordaire in this as in most cases implicitly adopts, have tried to overthrow these simple results of experience by means of utterly erroneous theories; but another German author, Von Kiesenwetter, has again returned to the true track, and given a correct and lucid description (Nat. Ins. Deutschl. vi. pp. 224–226). This, then, may be considered sufficiently well established,—that if a *bonâ-fide* "skip-jack" finds himself lying on his back, he at once folds up his legs and antennæ, pressing them closely to the body, so that as little of them as possible protrudes; he then pushes back the prothorax so far that the point of the prosternal spine meets the salient middle part of the mesosternum, for which purpose it becomes necessary to bend the body in, so as to form an obtuse angle; the animal then begins to contract the flexors of the prothorax with constantly increasing force against the point of support on the mesosternum which has thus been obtained: suddenly it lets go; the prosternal spine glides rapidly along the groove in the mesosternum and down in the dip which is adapted to receive it; the most prominent parts on the dorsal surface of the animal, particularly the bases of the elytra, are thereby violently struck against the ground, and, by the recoil, the whole body of the animal is tossed up into the air: while in the air, it unfolds its legs, in order to be able to catch a hold with its claws if it comes down on its legs. It is apparent that a very free articulation between the prothorax and mesothorax is necessary for this operation; and accordingly we find both the pronotum and the bases of the elytra steeply inclined towards the articulation; it is further apparent that the prosternal spine, the prolonged mesosternum, with its little dip in front, its sliding plane, and the deep excavation at its root, play a principal part; and from this starting-point a great many conclusions may be safely made. It is evident why the skeleton of the spring-beetle is so hard—because otherwise it would not possess the requisite elasticity to effect a sufficiently strong recoil from the ground; we perceive why the whole shape is moderately long and narrow, with rounded points in front and behind, closely fitting edges, and elliptical outline both in the longitudinal and cross sections, why all the limbs are more or less completely adapted for being received into grooves on the lower surface of the head, sternum, and abdomen, the legs for being folded up, the hip receiving the femur, this again the tibia, and the tibia in its turn receiving the foot; finally, we see the necessity of the prothorax being long and shaped like a cushion above and below, far thicker than the exigencies of the muscles of the neck and legs would require. It is clear that in the same proportion as these arrangements

are more complete, more carefully adjusted and balanced, the greater is the power and accuracy with which the animal exercises its springing faculty, and the more often can it repeat it; in the same degree as the skeleton is harder and more naked, the prothorax longer (whereby the clicking-joint is placed more in the middle), its hind quarters longer and more pointed, the joint between the elytron and pronotum more free, the root of the elytra thicker and their ribs higher, the more perfect is the performance of the clicker.

We possess even in our native species a more than sufficiently rich series of exemplifications of all these and many more modifications of the different parts composing this machinery, which are combined in infinitely varied ways.

But if it be so (and after all that has been said I do not suppose that anybody will doubt it), that this "clicker-business" really is the fundamental peculiarity in the *Elater*-type, why, then, is it that entomologists refuse to admit into the family of Elateridæ a numerous series of beetles (such as Throscidæ, Melasidæ, Eucnemidæ, Cebrionidæ) in which the selfsame structure recurs in all its essential points, but which are not considered true, genuine, and *boná fide* clickers? What is the difference? If the question is put in this straightforward manner, the answer is not difficult. The fact is evidently this, that the springing-apparatus has not yet been so thoroughly studied that the type of it can be recognized with certainty in the cases where it is not carried out to its fullest perfection. Only thus can it have happened that this feature of the structure is so far from having been brought forward as an essential and fundamental character, that, on the contrary, it has been given up in despair, as "leading to entirely illusory characters" (Lacordaire, Gen. d. Coléopt. iv. 1. p. 131), and unfit to distinguish the family of Elateridæ either from the intermediate divisions just mentioned, or even from Buprestidæ. But if this at present is the whole upshot and result of scientific inquiry in the matter, it is quite clear that neither Elateridæ nor Buprestidæ are really understood. That they are nevertheless constantly placed side by side in the systems is therefore owing merely to the similarity of their external habitus; and then the loss of that mark of distinction, which was shown to be valueless in the preceding part of this paper, will be severely felt. The great question which still is unanswered, and which we shall next attempt to solve, is this:—Does the similarity in shape of Elateridæ and Buprestidæ signify one and the same thing, express one and the same type? Only when this is answered can we hope to be liberated from the spell of illusion.

Let us then, first of all, on some *Buprestis* lift the prosternal

spine out of its bed on the mesosternum, and we shall then find that this bed is shaped so as to fit the spine exactly, so that there is nothing different in the arrangement from what we find, for instance, in Carabi and in Dytisci; that is to say, it has no other object than to procure a firm junction between the parts. And this same tendency to firmness, and even rigidity, is not confined to this point, but is carried out in the whole structure, by every means which the elements of the body offer, along the whole ventral surface—that is to say, in that line which in Arthropoda corresponds to the spinal column of Vertebrata. We observe, first, the peculiarity that not only the mesosternum and episterna mesothoracica, *but also the epimera mesothoracica*, take part in the articulation with the prothorax; secondly, the complete coalescence of the ventral segments, save the last three; finally, that the abdomen prolongs itself with a very strong spine or wedge between the posterior coxæ, reaching the metasternum, embracing also the posterior coxæ laterally by means of two large lobes, which reach the epimera metathoracica. In most Buprestidæ there is this further provision, that the pronotum, by a backward prolongation, wedges itself in between the elytra. Whilst now in Carabi the firmness and compactness of the body is required to render them fast runners, in Dytisci to increase their power of swimming, its significance in Buprestidæ is to render their flight strong. They are the Colibris amongst beetles, creatures fitted for living in strong sunlight, with markedly sculptured surface, sparingly endowed with hairs, rich in glittering metallic colours, resplendent with green, gold, purple, and azure—with a broad metathorax for the powerful muscles of the wings—of ovoid figure, pointed behind, with the centre of gravity between the wings, which are without cross folds (unique amongst Coleoptera), so that they can be unfolded for flight with lightning speed—with large oval eyes, presenting numerous fine facets, calculated for broad daylight—short naked antennæ, with spots of pores—short folding legs which, though not of very characteristic form, pointedly retain their character of walking legs, being of very nearly equal length, the trochanters of the posterior pair not supporting—the feet also, by their broad soles and membranaceous pads, announcing themselves as the representative of the herbivorous type of insect foot within the series of Serricornia*. Looking to their internal structure, we find that their tracheal system is extremely rich in air-vesicles—a peculiarity which does not seem to reappear amongst Coleoptera, except in Scarabæi, which, next to the Buprestidæ, contain the most powerful fliers of the order.

* Ann. & Mag. Nat. Hist. ser. 3. vol. xv. pp. 182–183, "On the Classification of Cerambyces."

Then let us take some species or other (it does not matter which) of the divisions of Throscidæ, Melasidæ, Eucnemidæ, Elateridæ, or Cebrionidæ, and let us lift the prosternal spine out of its bed on the mesothorax, and we shall find that the bed is not by any means constructed only with regard to that spine; so that the arrangement is entirely different from that of the Buprestidæ. The place in which the prosternal spine rests always terminates behind in a deep excavation, which would be as superfluous for the accommodation of that spine as it is necessary for the accommodation of the "springing-spine" (mucro saltatorius), the essential instrument of the springing beetle, which has hitherto been either overlooked or misunderstood, having been confounded with the prosternal spine. The fact is, that when the articulation of the prothorax with the mesothorax is not very free (that is, in most cases), the springing-spine is, on account of the limited space, placed on the upper surface of the prosternal spine, forming an angle with it, and therefore hidden by this when the animal is viewed from below. It is only when drawn out by the animal for use in springing, or when the prothorax is entirely loosened, that it is seen. By degrees, as the articulation of the prothorax with the mesothorax is freer, and the mesothorax more salient, the springing-spine assumes a more horizontal direction, and appears behind the posterior extremity of the prosternal spine; the boundary between the two is in this case marked by a small tooth, which is nothing but the extremity of the prosternal spine. Finally, in those Elaters where the joint in question is entirely free and open below, this little tooth also disappears, and with it the last indication of the original position of the springing-spine, which in this last case appears simply as the continuation of the prosternal spine.

We shall do well to pause a few moments after having gained these results. We have seen that the larvæ of Sternoxi group themselves round two distinct types, and we now see this bifurcation confirmed in the perfect animals by equally decisive and thorough-going marks of distinction. We found the type of the Buprestidæ to be that of an animal organized for flight, that of the Elateridæ to be characterized by the springing-mechanism. But the latter type is less one-sided than the former. The *Buprestis*-larva and its congeners are always xylophagous, burrowing in timber, and there is consequently not much room for variety in shape; whether the egg is deposited in clefts of the bark of trees, in the tenderer stem of herbs and shrubs, or in the parenchyma of leaves, the demands which the propagation of the species makes upon the structure of the beetle remain upon the whole the same; but time and strength will at the same time be to such a

degree engrossed by this part of its activity that the beetle's own nutritive life cannot be expected to express itself very strongly in its structure. The Elateridæ, on the contrary, are, as larvæ, carnivorous; and consequently we find amongst them a a great variety of forms, according to the mode of life of the prey; and the corresponding demands for the equipment of the perfect beetle with regard to propagation causes a far richer variety of form among the Elateridæ than among the Buprestidæ. In those Elateridæ which, as larvæ, hunt their prey in closed galleries in timber, the faculty of springing is reduced in power and facility, whilst that of flying is more developed, and the animal then approaches somewhat to Buprestidæ in outer form, sculpture, &c.,—thus, particularly, in Melasini and Eucnemidini, especially in exotic genera, as *Pterotarsus*. Those Elateridæ, on the contrary, which, in the larval state, seek their food in less circumscribed localities are more developed as "clickers" than for flying, and therefore occupy a place in every respect opposite that of the others: excellent instances of this combination are afforded by many species of the group *Diacanthus* and congeners. The majority of Elateridæ stand between these two extremes, inclining sometimes more to one than the other. Elateridæ are consequently to a certain extent placed under equal conditions with true carnivorous beetles—that is, such as live on animal food in all stages of their existence; and it is therefore natural to expect further analogies with such beetles—as, for instance, with Carabidæ. Accordingly we find that they live in shade, or are mostly active at night, with close, fine, and minute sculpture, regularly ribbed (striated) elytra covered with short and fine hair; their colours are mostly dark and dull, principally black, brown, or ferruginous; some are more vividly coloured, red, or with checquered light and dark designs, or even with metallic lustre; but they rarely attain and never surpass that degree of splendour and lustre which is met with amongst Carabidæ. Elateridæ possess similar round eyes, and longer antennæ; and though the legs, for the sake of the springing-faculty, cannot be very strongly developed, they nevertheless retain the character of running-legs by the trochanters of the third pair being large and "supporting," as in Carabidæ*. Nor is the analogy with Carabidæ deficient in this point—that amongst Elateridæ one group (viz. Cebrionini) is calculated for digging in the ground, just as several genera amongst Carabidæ. It is, however, time to turn our attention to the structure of the mouth.

* Latreille has already pointed this out in the *Elateres* properly so-called: "Femora postica ad basin appendice trochanteriformi instructa" (Gen. Crust. et Ins. i. 2. p. 248).

VII.

With regard to that series of families into which the division Sternoxi has been resolved, the constant verdict of modern authors is to the effect that the organs of the mouth are destitute of systematic value, and upon the whole are much reduced, which seems to mean that they are rather short and do not project much from the mouth (Lacordaire, Gen. des Coléopt. iv. 21. pp. 95, 96, 131). The same assertion is often made also with regard to other groups. Such a view, however, when properly considered, is always found to be erroneous; for if the structure of the mouth really remains the same in an extensive series of animals, this fact is not valueless, but, on the contrary, affords a never-failing indication of their near relationship. I say "never-failing," for in no case has it ever been found at variance with the testimony of the rest of the structure. If, then, the result of the investigation of the mouth is thought unsatisfactory, the fault lies in the preconceived views of the observer who rejects its testimony. It is the method of so many modern authors which leads to results inconsistent with nature; and if they find that the structure of the mouth is at variance with these results, it is said to be without systematic value, instead of that circumstance being accepted as a proof that the results obtained are erroneous. Authors are bent on distinguishing, and hunt after marks of distinction—for what? For those groups and divisions which are constantly being proposed on the strength of mere external and often accidental similarity in shape. Of course, the careful examination of every part of the animal accessible to the pocket magnifier, which constitutes the method of so many even of the best modern entomologists, does occasionally lead to the discovery of good and useful characters for classification; but such a method has really only a limited claim to the name of natural method which it assumes. It approaches the natural system in many points, but it attains merely a superficial contact; it never penetrates the essence of the natural system. Much material is sifted and laid in store by that method; but the scientific edifice of a natural system makes no progress. Not even the mere elementary task of procuring a survey of the material can be mastered by that method: the enormously complicated animal composition is much too intricate to be overcome by artificial classification; it must be realized in thought and imagination in its unity and through all its ramifications.

In order to appreciate properly the organs of the mouth, they, as well as other animal instruments, must be regarded both in their own mutual relation and in their relation to all the other parts of the organism. In Buprestidæ their develop-

ment depends partly on the nutritive side of the animal's life, partly on the requirements of propagation; but the latter predominate. The mandibles present the appearance of short, exceedingly strong, quadrangular, pointed, hollow chisels, with sharp or somewhat serrated edges, with a deep and roomy socket above, and a very prominent globular condyle below, which strongly reminds us of the head of the human femur. Their muscles are so large as to necessitate a very large and round skull. The mandibles are principally in the service of the propagation of the species, since it is by their means that the beetle, after its transformation, works its way out of the timber; nor is it improbable that they are employed in making preparations for the deposition of the eggs, viz. by facilitating the application of the ovipositor to suitable parts of the bark. They are largest in those Buprestidæ which, as larvæ, burrow deepest, and the food of the beetles consists in that case of leaves and buds*. In the group of Anthaxini, on the contrary, they are somewhat less developed; they are flatter, their extremities laciniated, and their inner margin less deeply excavated: in this case the beetle feeds upon pollen, and possesses peculiar bag-shaped extensions on the œsophagus for the preliminary collection and softening of this kind of food. The maxillæ are broad and powerful, their lobes small, coriaceous, covered with very stiff, short hairs—the outer one broader, but the inner one more pointed, than in the leaf-eaters. The mentum affords, by its clumsy shape and considerable thickness, a good support from below for the play of the mandibles and the maxillæ. The lingua is without stipes, small, thick, coriaceous, undivided, armed in the same way as the lobes of the maxillæ; the labial palpi are short, with much-reduced basal joints, but with free protrusible stipites. The palparium in both pairs of palpi is large (the terminal joint truncate) in those Buprestidæ which have to choose timber for their young; but it is small (the terminal joint obovate) in those which place their eggs in thin branches, stems, and parenchyma.

The great variety of forms amongst Elateridæ is expressed also in the structure of the mouth. Of this we meet with two types, one being principally calculated to serve the nutritive life, the other to serve the propagation of the species.

* According to information from Tranquebar, the large *Sternocera chrysis* swarms round certain trees, eating their leaves, as the cockchafers with us. In some years it occurs in great numbers. Once it happened that a box received from that locality contained nothing but hundreds of bellies of this Buprestid. The native who had been sent out collecting had understood the matter in his own way, and taken off the shiny green shields, which his countrywomen use for ornaments.

The first type is met with in those Elateridæ of which the larvæ hunt in the fields, under leaves and moss, in meadows or in decaying wood. The care of the offspring is here so slight that the beetle has time for running about to seek food for itself; and as this consists of pollen, the mouth resembles not a little that of those Cerambycidæ which feed on the same substance, particularly Lepturini. The labrum protrudes, covering the mouth from above. The mandibles are triangular, gradually pointed and arched, of no considerable strength, with small socket and condyle; the joint is cleft into two sharp teeth, one above the other; the whole inner margin is arched, and presents a sharp edge with a marginal fringe. The maxillary lobes are large, particularly the outer one; their skin is thin, and their edge covered by a close beard. The mentum is short and thin; the stipites of the labial palpi long, very moveable; the lingua large, broad, and bifid, with thin skin, and the margin closely fringed with hair, the stipes narrow and strong; the terminal joint of the palpi almost always subsecuriform, with a large palparium. This is the structure of the mouth in the group of Elaterini.

The other type, which is almost exclusively governed with regard to the propagation of the species, is met with in those Elateridæ which, as larvæ, hunt in more confined localities, particularly in galleries in wood. The care of the eggs, together with the considerable labour which may fall to their lot in order to get out of the timber, leaves very little time for the beetles to seek food for themselves; and according to the greater or less preponderance of these considerations, two modifications of this type are developed, of which one is analogous to that of Callidiini amongst Cerambycidæ, the other to that of Asemini and Prionini in the same family.

The first of these modifications characterizes the group of Eucnemidini, and differs less considerably from the structure of Elaterini. The labrum is more or less obsolete. The mandibles are very powerful, and still furnished with an edge; but it is more or less clumsy and thick, and is without any fringe; the socket and condyle are large, the point sometimes entire, sometimes divided into two or more sharp teeth. The other two pairs of buccal organs are very small in proportion. Maxillary lobes and lingua considerably shortened, and rather to be described as covered with fine hair than as being provided with a marginal beard. The terminal joint of the palpi is of proportionally enormous size, broad, and securiform, with very large palparium.

In the second subtype, characteristic of the group Melasini, the labrum has entirely disappeared; the mandibles are of

enormous strength, with colossal socket and condyle; at the base they are so much extended both upwards and downwards that they appear as if they carried horns when seen from the back; their inner margin is destitute of fringe, excavated like a spoon, and the point sometimes whole, sometimes divided into several powerful and sharp teeth. The two other pairs of buccal organs are extremely small. The palpiferous stalk of the maxillæ is shaped like a joint, and stands out from the stipes; there is only one lobe, which is small, with thin skin and fine hair. The mentum is very small and thin; stipites palporum labialium not separate; lingua small, short, obtuse, undivided. The terminal joint of the palpi is very large, oviform.

It is a matter of course that both in Buprestidæ and Elateridæ the mouth is turned more downwards, in proportion as the beetle has more to do with wood, on account of the habits of the larva. The fore legs being, in both families, weak, with globular coxæ, the prothorax is naturally short, unless the clicking-apparatus be strongly developed, in which case also the organs of the mouth are larger, more protruding, and calculated for eating pollen. These, then, require protection during the work in earth, moss, and decaying wood, where the eggs are to be placed &c., which protection is afforded by a peculiar prolongation of the prosternum, a "chin-lobe" (*mentonnière*), by means of which the beetle can hide the organs of its mouth when the head is not protruded. Such a chin-lobe is therefore found in all Elaterini; but it is of varying size, more or less distinctly marked by a transverse groove, more or less turned downwards, according to the degree in which the Clicker-type is developed in the species. When authors deny (as Lacordaire does in Gen. des Coléopt. iv. p. 224) that such genera as *Campylus* and *Cebrio* possess this chin-lobe, and find one of their essential characters in this defect, this must arise from their not having sufficiently investigated the character of that organ, so that they are unable to recognize it when it is somewhat different in appearance from its most general form. For it must always be kept in view that this chin-lobe is merely a prolongation of the prosternum alone, which is indicated by its being separated, be it ever so short, from the epimeron on either side by a small sharp notch. Thus understood, the chin-lobe becomes one of the most essential characters of the group of Elaterini.

VIII.

On a former occasion I gave an account of the internal anatomy of Buprestidæ*, and I shall here offer a corresponding

* Oversigt over det Kongelige Danske Videnskabers Selskabs Forhandlinger (Transactions of the Royal Danish Society of Sciences), 1847, no. 3. pp. 24–35.

account of that of Elateridæ, only mentioning such details of the anatomical structure of Buprestidæ as will serve to clear up the differences between the two families. The statements I have to offer with regard to Elateridæ are the results partly of my own investigations of the anatomy of the insects, partly of a considerable number of dissections made by Dr. Fr. Meinert.

The tracheæ are without vesicles; the spiral ribs of the internal membrane of the larger trunks in the head and thorax are generally furnished with fine spines. The fat is not present in great quantity, though the less active species (as *Agriotes lineatus, obscurus, sputator*) have more of it; it is often of a yellowish colour, on account of the numerous yellow cytoblasts contained in the fat-cells.

True salivary glands are wanting, the cells secreting the saliva being not more numerous than can be accommodated in the walls of the pharynx, on either side of which a series of orifices give outlet to the ducts from these large and round glandular cells.

The digestive tube is of very simple construction, and so short that it never much exceeds the length of the animal, often only by a sixth or an eighth, more rarely by one-third. The pharynx is flat, strongly narrowed behind. The œsophagus is very short, gradually widened into the very small craw, which reaches a shorter or longer way into the prothorax. The muscular membrane of the œsophagus and the craw is rather weak; the inner membrane is covered with fine stiff hairs, which are directed forwards, more or less conspicuously arranged in longitudinal rows. The gizzard is very small, and in reality but little more than a pylorus formed by the narrowing of the craw, whereby the hair spines are made to stand closer together, so as to form a reversed wheel.

The stomach is cylindrical, straight, and reaches more or less far into the abdominal cavity; in front it is club-formed, distended, and the anterior end often protrudes so much that it receives the gizzard in a kind of dip. The muscular membrane of the stomach has in some cases equally well-developed longitudinal and transverse muscles, forming a net of quadrangular meshes, through which the layer of glandular cells peculiar to the stomach protrudes like warts; but in other cases the transverse muscles are weak, whilst the longitudinal ones are very powerful and strongly striated (as in *Lacon murinus, Diacanthus æneus*), through the intervals of which the cellular stratum protrudes as parallel longitudinal rows of small semiglobular cæca. The intestine is in the majority of cases straight, smooth, without prominent longitudinal bands or intestinal warts, mostly with unstriped transverse muscles, and without marked distinc-

tion between small intestine, large intestine, and rectum. But in *Cebrio* it is slightly winding, with powerful transverse muscles, the posterior half distended so as to form first a colon of considerable dimensions, in its posterior part furnished with many small cæca, and finally a short rectum, markedly separated from the former, and with powerful longitudinal muscles.

There are *four* rather short (in *Throscus* very short and thick) Malpighian vessels, of which the ends are closed and quite free, although each pair is closely held together by minute tracheæ. They consequently do not form two loops such as are represented by Léon Dufour (Ann. d. Sc. Nat. 1824, iii. pl. 2. figs. 3, 4).

Each of the testes consists of a bundle or tassel of shorter or longer folliculi, which are closely united by intertwined tracheæ and imbedded in fat, but not enclosed in a common bag. The testes are situated in the anterior portion of the abdominal cavity, close to the back, over the digestive tube, which runs close under them through the ring which is formed by the vasa deferentia. The number of follicles in each testis is very variable: in *Adrastus limbatus* there is only one, in *Cryptohypnus quadripustulatus* nine, in *Lacon murinus* more than twenty; but within the natural groups their number seems to depend principally on the size of the animals, so that it is upon the whole greater in the larger species and less in the smaller ones. Thus, whilst *Diacanthus æneus* has fifty, *D. tessellatus* forty, and *Agriotes lineatus* and *obscurus* fifty, *Agriotes sputator* has only twenty-four, *Ampedus balteatus* twenty, *Limonius minutus* nine to eleven; again, *Athous niger* has seventy, *A. ruficaudis* forty, and *A. subfuscus* twenty. All these numbers are approximate, as in each species the number vacillates between certain limits. In *Cebrio* the testes are distinguished by their extraordinary length and slenderness; they consist of more than 100 follicles placed on short stems in longitudinal rows, round the thin vas deferens, which occupies the middle.

The vasa deferentia are long, closely wound, and first extend a considerable way backward, passing the vesiculæ seminales, whereupon they bend forward again to the point where they join the ductus ejaculatorius. Near the testes they are slender, but increase by degrees in thickness, without, however, usually assuming very remarkable dimensions, except in species where they are very short (as in *Cryptohypnus quadripustulatus, Limonius minutus, Campylus linearis*); in species where they are very long they do not become very stout (as in *Ampedus sanguineus*, where they reach about 11·4 millims., in *Diacanthus æneus*, where they attain 19·2 millims., in *Athous ruficaudis*, where the length is about 11 millims.). In some species (for instance, *Agriotes aterrimus, Diacanthus tessellatus, Athous niger*, but not

A. ruficaudis) a short lateral branch starts from the point where they bend forwards again. In *Cebrio* the vasa deferentia, though very long, are towards their lower extremity suddenly extended into a long winding folliculus, of which the circumference is five or six times that of the thin part.

The ductus ejaculatorius is short, thick, and clumsy; it receives at the top, besides the vasa deferentia, three pairs of glandular vesicles.

The first pair of these, which are more properly described as vesiculæ seminales (spermatophorous glands), vary considerably in size and shape, though they form generally the most conspicuous parts of the interior sexual organs of the male. In *Diacanthus pectinicornis* they are fusiform, unusually small, 1·2 millim. long, whilst the ductus ejaculatorius in this species is particularly thick, club-shaped, and about 3·6 millims. long. In *Athous niger*, *ruficaudis*, and *subfuscus* they are, on the contrary, very large bags, of oval, on the inside somewhat concave form; in *Adrastus limbatus* and *Diacanthus tessellatus* the shape of the bag is still more arched and the inner anterior angles somewhat produced; in *Limonius minutus* and *Diacanthus bipustulatus* the curvature increases, and in the last-mentioned species the anterior angles are likewise produced; this protraction of the angles is further increased in another series of species, and the angles are variously wound, as in *Cryptohypnus quadripustulatus*, *Agriotes aterrimus* and *marginatus*, and *Ampedus balteatus*; in *Lacon murinus* the anterior angles are even divided each into two unequal branches, which are wound in spirals each in its own direction; in *Agriotes obscurus*, finally, the vesiculæ seminales have the shape of a stout, arched and winding tube, towards the end spiral, with a short, thick lateral branch, whilst in *Agriotes lineatus* they differ by being wound in double spirals at their end. In *Cebrio* these organs are slender, not stouter than the extended part of the vas deferens, with arched and spirally wound ends. But with regard to all these varieties of form, it must be observed that they embrace only the outer forms of the vesiculæ seminales, whilst the inner membrane is quite independent and does not by any means follow the external outline of the organ. This inner membrane forms a complicated system of cavities and expansions communicating with one another. In *Cryptohypnus quadripustulatus* its anterior part terminates in two long, extremely fine tubes, which accompany the anterior winding part of the vesicula. In *Agriotes obscurus* it forms a long tube with various dilatations, and is accompanied by a darker band, of alternating width, and of which the lighter parts show themselves to be composed of perpendicular cellular glands. The tube enters into the above-mentioned thick lateral

branch of the organ, runs through its whole length, and then doubles back and continues into the extreme end of the spirally wound part of the vesicula seminalis: from the point where it doubles back, near the extremity of the lateral branch, a long slender cæcum arises, of which the inner cavity soon becomes obsolete, and which then becomes exceedingly thin and pointed. The inner membrane is very firm and tough, and often pushes through the surrounding cellular stratum and the external membrane in the process of dissection under water.

The second pair of glandular follicles partly cover the vesiculæ seminales when the sexual organs are observed from below; they are generally cleft into two branches—one very thick and clumsy, behind the top of the ductus ejaculatorius, the other, which is more slender, in front of this (*Cryptohypnus quadripustulatus, Lacon murinus, Agriotes aterrimus* and *marginatus, Ampedus balteatus, Diacanthus tessellatus*). In other cases they are shaped like bags, the terminal part bent like a ram's horn (*Limonius minutus, Diacanthus bipustulatus, Athous vittatus*); or the terminal portion may besides be deeply bifid (*A. niger*) or be furnished at the base with a tubiform arched branch (*A. ruficaudis, Campylus linearis*). In *Adrastus limbatus* these follicles are dilated into the shape of balloons, and are very large, almost four times as large as the vesiculæ seminales; in *Cebrio* they are likewise very large, and the bags of elliptical shape.

The third pair of glandular follicles attached to the ductus ejaculatorius are almost always tubiform, of very varying stoutness and length: only in *Adrastus limbatus* have they the same considerable size and balloon-shape as the second pair of follicles possess.

The penis is narrow, spear-shaped, with a pair of narrow valves, which are generally furnished with a small tooth near their extreme point.

The ovaries are divided like the fingers of the hand. The number of fingers varies considerably, according to genera and species, but generally according to the same rule as that of the folliculi of the testes, so that the number is greater in the larger species, less in those of smaller size. Their number, however, does not generally exactly correspond with that of the folliculi testis, as may be seen by the following series of examples:—*Diacanthus æneus* has eighty to ninety fingers, *Athous niger* seventy to eighty, *Melanotus castanipes, Diacanthus pectinicornis, sjælandicus,* and *Athous ruficaudis* about fifty; *Lacon murinus, Agriotes aterrimus* about forty; *Diacanthus tessellatus, Limonius cylindricus, Athous vittatus, Campylus linearis* about thirty; *Cardiophorus asellus, Ampedus sanguineus, Diacanthus bipustulatus, Athous subfuscus* twenty to twenty-six; *Agriotes lineatus, ob-*

scurus, sputator, Ampedus balteatus fifteen to eighteen; *Cardiophorus ruficollis, Agriotes marginatus* twelve; *Cryptohypnus quadripustulatus* and *Adrastus limbatus* five. The oviducts are short, and open through a short common duct into the under surface of the vagina at a varying distance from its top; when filled with eggs, their appearance is quadrangular. The eggs are rather small, of short oval form: mature eggs, when taken out of the oviducts, measured in *Agriotes marginatus* 0·25 millim. in length, and 0·169 in width; in *Limonius cylindricus* 0·304 millim. by 0·179 millim.; in *Diacanthus bipustulatus* 0·309 millim. by 0·184 millim.; in *Diacanthus pectinicornis* 0·429 by 0·232 millim.

The vagina is either long and tubiform, or short and club-shaped. The tubiform type of vagina is, in places, of varying thickness, strongly curved (*Diacanthus pectinicornis*) or sharply bent at an angle (*Melanotus castanipes, Limonius cylindricus, Ampedus sanguineus, Diacanthus æneus*); when the oviducts join the vagina far behind the end of the latter, it is winding or even forms a spiral (*Lacon murinus, Agriotes marginatus*). The club-shaped vagina is not often gradually widened towards the fore end (*Adrastus limbatus, Agriotes lineatus*); more frequently the thick fore end is sharply defined, and besides is constructed so as to assume various forms (*Cardiophorus ruficollis, Cryptohypnus quadripustulatus, Agriotes aterrimus, obscurus, Diacanthus tessellatus, bipustulatus, Athous niger* and *subfuscus*). The internal surface of the vagina is furnished with a greater or smaller number of spinulose plates of chitine, or with spines placed in rows, or with both contrivances together, which do duty in the act of copulation as retaining instruments. The most frequent combination is a couple of lateral plates (*Cardiophorus ruficollis* and *asellus, Lacon murinus, Agriotes aterrimus, lineatus, obscurus, sputator, Diacanthus tessellatus, pectinicornis, sjælandicus, bipustulatus, Athous niger, ruficaudis,* and *subfuscus*). The plates are of different sizes, oblong, often with ribs and marginal teeth (*Athous niger* and *subfuscus*); and in some cases a second pair of plates over them are met with, which have spines on their inner margin (*Cardiophorus asellus, Diacanthus sjælandicus* and *tessellatus*); in *Lacon murinus* there are, besides the pair of plates first mentioned, a number of long spines at the anterior extremity of the vagina. When plates are wanting, the spines are so much the more abundant (*Agriotes marginatus, Ampedus sanguineus* and *præustus, Diacanthus æneus*).

The foremost dilated extremity of the vagina receives the semen during the act of copulation, and thus serves as a kind of bursa copulatrix, but is rarely separated by a constriction, which, however, is the case in *Cardiophorus ruficollis* and *asellus* and in *Campylus linearis*.

The spermathecæ likewise assume the form of dilatations of the anterior free extremity of the vagina. Their shapes are very various, sometimes that of a conic protuberance (*Cryptohypnus quadripustulatus, Diacanthus tessellatus* and *bipustulatus*), sometimes that of a tolerably long tube (*Agriotes aterrimus*), or of a short bag terminating in a tubiform continuation (*Melanotus castanipes, Limonius cylindricus*), or of two (*Diacanthus æneus*) or three (*D. pectinicornis*) short thick branches; in *D. sjælandicus* they are represented by five long tubes situated inside the vagina; in *Ampedus balteatus* there are two long club-shaped tubes proceeding from the top of the vagina, and five others starting from the duct of the accessory gland. This last case effects a transition to those cases where the tubes of the spermatheca do not open immediately into the vagina, but into its upper tubiform part, into the end of which the accessory gland opens, and which therefore may be looked upon as the duct of the latter. In *Cardiophorus ruficollis* this conduit is thin, towards the end wound and twisted, and bears on one side more than sixty short spermathecal tubes*. In *Agriotes marginatus* this duct carries close before its dilated end a long spermathecal tube, from which, again, a lateral appendix branches off towards its extremity. In *Agriotes obscurus, lineatus,* and *sputator* the duct is of extraordinary length, and near the base twisted in a double spiral, one outside the other; beyond this part, a very long twisted spermatheca separates itself from it, and beyond this, again, the duct carries a varying number of shorter club-shaped tubes along its sides; and, besides this, there is in *Agriotes obscurus* a short cylindrical tube, and in *A. lineatus* a somewhat larger deeply bifid bag, placed at the point of junction between the vagina and the duct of the accessory gland. In *Throscus,* finally, we find two small round spermathecæ, of which the ducts unite into a short common duct inserted near the base of the duct of the accessory gland; in their natural position they are placed upon the vagina like a pair of spectacles.

The accessory gland of the spermatheca in Elaterini is large

* The structure in *Cardiophorus asellus* is very similar; and there can consequently be no doubt that Stein (Anat. u. Physiol. d. Ins tab. 5. fig. 1) has represented the sexual organs of this or an allied species of *Cardiophorus*—not, as he thinks, of *Athous hirtus* (*niger*). To his account of the duct of the accessory gland, however, it should be added that the serrated form he represents is caused by the great number of lateral tubes (nearly forty), which do not join the duct at right angles, but lie along it slanting forwards. In Stein's drawing are also wanting the two elongated triangular plates of chitine (united at their ends) which are situated over the larger plates represented by him in the vagina; and, besides, the *seminal groove* is omitted, which here, as is usually the case, extends from the stem of the lateral follicle to the base of the common oviduct.

and shaped like a hand. The basal part increases in size with the number of the fingers; in *Diacanthus pectinicornis* it is divided into two or three lobes, with numerous short fingers. The number of these latter varies very much (in *Cardiophorus ruficollis* two, *Melanotus castanipes* three to five, *Diacanthus bipustulatus* five to six, *Campylus linearis* six to seven, *Diacanthus tessellatus* ten, *Athous subfuscus* thirteen, *Agriotes aterrimus, lineatus, Limonius cylindricus* twenty, *Athous niger* twenty to thirty). In *Lacon murinus* the fingers are ramified, with small triangular dilatations in the angles; the gland opens with a short stem in the side of the somewhat swollen and muscular end of the duct. In *Throscus,* on the contrary, the accessory gland is a simple, thick, but-little-wound tube, inserted at the base of the bursa copulatrix.

Several Elateridæ possess, besides, a pair of very large vaginal glands which have more or less thick walls, are closely united at their bases, and inserted above the oviducts in the receding angle between them and the vagina. This is the case in *Diacanthus sjælandicus* (but not in *D. pectinicornis*), in *Agriotes aterrimus, lineatus, obscurus, sputator,* and *marginatus.*

Many Elateridæ possess a peculiar, rather firm, inside more or less chitinized, funnel-shaped seminal groove, reaching from the base of the duct of the accessory gland to the mouth of the oviducts, or, in the cases where the vaginal glands just described occur, to their point of insertion—for instance, *Agriotes sputator* and *marginatus, Athous subfuscus,* and *Campylus linearis.*

Finally, many Elateridæ possess a peculiar kind of lubricating glands, of which the yellow oily secretion is destined to facilitate the sliding of the vagina in the muscular tube. In *Agriotes aterrimus, obscurus, sputator,* and *marginatus* they are oval, almost reniform; in *Diacanthus tessellatus* very long and slender, a little club-shaped toward their extremity. In *Melanotus castanipes* they are long, furnished with a lateral branch, and their end is tortuous; their walls are distinctly observed to be filled with transparent glandular cells placed edgewise; towards their mouth they are abruptly constricted, and then continue themselves as two minute tortuous tubes inside the outer membrane of the vagina, form a small dilatation, and finally perforate this membrane so as to discharge their contents in the muscular case of the vagina. The whole glandular tube can be moved by means of striped muscular fibres.

The ovipositor is a long, thin, chitinous tube, supported by a pair of small lateral flaps, terminating in a small joint covered with short and stiff hairs, which carries the vaginal palpi.

The male of *Lacon murinus* possesses a pair of bag-shaped scent-glands, of not inconsiderable dimensions; they are situ-

ated in the abdominal cavity, and can be pushed out behind the dorsal shield of the penultimate segment. When they are retracted in their natural position, numerous ducts, proceeding from the glandular cells (which are accumulated so as to form acini), are seen to open at their bottom. They are furnished with striped muscular fibres, fixed to the bottom and on one side, and when they are protruded, the greater part of the cellular tissue and muscular fibres follow the walls of the bags, and are consequently then situated inside the bags, which are turned outside in.

With regard to the nervous system, I have to observe that the ventral chords are not separated beyond the ganglion metathoracicum; but for the rest they are closely united, sometimes enclosed in one and the same neurilemma. There are eight abdominal ganglia, of which the first two are situated in the metathorax, the foremost of them close to the metathoracical ganglion; the seventh and eighth ganglia (the sexual ganglia) are as usual closely united. The nervous stems for the organs of respiration proceed as usual from particular small ganglia in front of the abdominal ganglia connected with the ventral cords.

If, now, we institute a comparison between the inner structure of Buprestidæ and that of Elateridæ, the essential results will be the following:—

BUPRESTIDÆ.	ELATERIDÆ.
The *tracheæ* furnished with numerous vesicles.	The *tracheæ* without vesicles.
Salivary glands very much ramified.	No *salivary glands*.
The *digestive tube* long, two or three times the length of the animal.	The *digestive tube* short, very little longer than the animal.
Œsophagus long, the craw large, situated in the hind part of the prothorax, in the mesothorax, or even in the metathorax.	*Œsophagus* very short, the craw small, situated in the fore part of the prothorax.
Œsophagus with large lateral dilatations in those species which feed on flowers.	Œsophagus simple, even in species feeding on flowers.
The *stomach* long, with two horns on its anterior extremity, spirally wound behind, very glandulous.	The *stomach* short, almost straight, without horns, very few glands.
The *intestine* bent at an angle, with strongly developed glandulous *colon*.	The *intestine* straight; the *colon* not at all distinct, or, rather, indistinctly marked; few glands.

BUPRESTIDÆ.	ELATERIDÆ.
Six *Malpighian vessels*, of which the ends are fixed to the angle of the intestine.	Four *Malpighian vessels*, with free ends.
The *folliculi testium* very long, tubular, at the base elliptically dilated; the ends of all the folliculi in each testis twisted into a spiral; each testis furnished with its own enclosing membrane.	The *testes* free; the folliculi short, more or less round, mutually free.
Two pairs of *vesiculæ seminales*,—one thick, pear-shaped; the other long, tubiform, closely twisted.	Three pairs of *vesiculæ seminales*, of which two pairs vary exceedingly in structure.
Spermatheca very simple, elongated, club-shaped, without accessory gland *.	*Spermatheca* of extremely varying, often very complicated structure, with large ramified accessory gland.
The *ventral cords* of the nervous system separated in their entire length.	The *ventral cords* of the nervous system separated only as far as the metathoracic ganglion.
The ganglia of the mesothorax and metathorax coalesced.	All thoracic ganglia separate.
Five *abdominal ganglia*; only the last three in the abdominal cavity. The first abdominal ganglion distinct from the metathoracic ganglion.	Eight *abdominal ganglia*; the last six situated in the abdominal cavity. The first abdominal ganglion united with the metathoracic ganglion.

IX.

The investigations of which we have given the results in the preceding pages prove that the mutual relation of these two families is very different from what was formerly supposed. With regard to development, structure, and habits of life, they appear as widely separated as two families can be, within the boundaries of the same principal division of animals. Amongst Serricornia, Buprestidæ occupy, in all stages of life, the same place as Cerambycidæ and, more particularly, Lamiini (*Lamia*, *Saperda*, &c.) amongst the phytophagous or cryptopentamerous Coleoptera. Elateridæ, on the contrary, are carnivorous as larvæ, and in that stage of their life very like the larvæ of Carabidæ, from which it follows (on account of the influence of the generative life on the structure) that also in their perfect state Elateridæ

* In the paper above quoted on the anatomy of Buprestidæ, the bursa copulatrix is erroneously represented as spermatheca, and the true spermatheca as accessory gland—an error which was easily rectified by the use of a better microscope.

exhibit analogies with Carabidæ, as far as their larvæ live in a free state, but with Buprestidæ when their eggs are deposited in timber and for that reason are developed rather with a view to their flying-capacity than to their "clicking"-powers. On the other hand, their feeding on pollen causes analogy with the phytophagous Coleoptera, particularly with the Cerambycidæ, because analogous food requires an analogous arrangement of the mouth. The starting-point of the modifications of the mouth being thus identical in both families, we find a parallelism between these modifications in those cases in each family where the work of propagating the species becomes so considerable as to occupy the whole time and strength of the animal in its perfect state: thus Melasini and Eucnemidini amongst Elateridæ correspond to Prionini, Asemini, and Callidiini amongst Cerambycidæ, just as those Elateridæ which frequent flowers correspond to Lepturini.

But if this be so, it seems that a new light is thrown on the whole series of Serricornia through these results. Very extensive investigations are necessary to place the relations of that entire division in a perfectly clear light, as our present knowledge of the great majority of these Coleoptera is entirely insufficient to afford us a deeper insight. But it may perhaps even now be predicted without presumption that the other divisions of that series likewise will show themselves parallel to different divisions in other series of the order of Coleoptera, the different elements of nutrition and propagation influencing the structure of the animals in a corresponding manner. The peculiar type of Coleoptera calculated for life in free air, which we describe as Serricornia, will most probably eventually divide itself into two principal series, each containing three or four families: in one of these series (distinguished by having four Malpighian vessels with free ends, and other characters) Elateridæ would correspond to Carabidæ, Cyphonidæ to Dytiscidæ, and Lampyridæ to Silphidæ and Staphylinidæ; whilst in the other series (distinguished by possessing, amongst other peculiarities, six Malpighian vessels, of which the ends are fixed to the intestine) Buprestidæ would correspond to Cerambycidæ, Anobiidæ to Curculionidæ, Melyridæ to Chrysomelidæ, and Cleridæ to Coccinellidæ.

Arguments derived from the general impression of the outward form, or from isolated considerations of some single feature in the structure or habits of the animals, would not avail against a comparison of this kind, which must be judged from those points of view which have been explained in the preceding parts of this article. Looking at the matter in this light, nobody can avoid being struck with the astonishing multiplicity

of combinations which the insect world exhibits also in this respect, seeing that in one single order at least four or five parallel series of great natural families can be pointed out, presenting so many cross combinations of characters in all their organic systems, always different in type, always analogous in modification, whilst the only other series of animals provided with true limbs, in the modern creation, viz. Vertebrata, hardly exhibits anything corresponding to this, except Marsupialia and Chondropterygii.

X.

It has been explained above how the Elateridæ, by degrees, as their habits of life associate them less with timber and wood, are less developed for flight and nocturnal life, and more for "clicking" and daylight life. The two extreme points of this development are indicated by *Melasis* and *Campylus*, which are connected by an infinite series of transitions; and *Campylus* approaches not a little to *Cantharis*.

The development of the *Elater*-type in the direction of flight and night life is characterized by the following features:—

1. The eyes become smoother, so that at last the facets protrude so little that they are not to be distinguished except when strongly magnified, and the whole cornea becomes quite shiny.

2. The sensitive pores of the antennæ * are more closely accumulated on the lower part of both sides of the joints, whereby well-defined poriferous spots are sometimes formed, usually from the third or fourth joint. Such spots, however, are not constantly distinguishable, except in *Melanotus, Adrastus, Agriotes, Sericosomus*, and *Ludius*. Amongst *Diacanthi, D. æneus* is distinguished by very small and little-depressed poriferous spots; and amongst the species of *Athous, A. rhombeus* is distinguished by double spots—namely, besides a lower series beginning on the third joint, also an upper series beginning on the fifth joint. The gigantic tropical species of the genera *Oxynopterus, Tetralobus*, and *Charitophyllus* possess extensive naked poriferous spots, particularly on the fan-branches of the male.

3. The forehead is more rounded downwards towards the mouth, the antennæ are more closely approached to one another, the prothorax is shortened, and the "springing-spine" (mucro saltatorius) is more distinctly separated from the prosternal spine; the legs are more completely arranged for being folded up and accommodated inside the margins of the body; the general outline of the body assumes a higher and at the same time more elongated oval shape, the edges are rounded off,

* See my treatise on Cerambycidæ, Ann. & Mag. Nat. Hist. ser. 3. vol. xv. p. 193.

the ventral surface more vaulted, the marginal ribs of the elytra effaced, their deflected lateral part (epipleura) is more bent in and diminished in size behind the coxæ; the legs are more arranged for running, with delicate feet and weak claws; the hairy covering becomes more close and silky, the sculpture less distinct, the ribs of the elytra lower, the colour duller, yellowish, brown, red, but never strongly metallic.

The development of the *Elater*-type in the opposite direction, towards springing and day life, is characterized by the following marks:—

1. The eyes become less smooth, the facets protrude more, and the appearance of the cornea becomes duller.

2. The sensitive pores are more equally spread over the whole surface of the antennæ.

3. The forehead slopes more gradually down towards the mouth; the antennæ are further removed from one another; the prothorax is more elongated, the mucro saltatorius presents a more direct continuation of the prosternal spine; the legs protrude more to the sides; the animal is less arched both above and below, the margins are sharpened, the whole outline becomes a more elongated ellipse; the marginal rib of the elytra becomes flatter and remains entire; the epipleura is more straight and broader; the legs are more especially adapted for walking and climbing, with club-shaped terminal tarsal joint and powerful claws; the body is more closely haired, the sculpture coarser; the ribs of the elytra are raised at the base; the colour is heightened often to metallic lustre, or to distinct design.

If every combination of characters drawn from this circle were used for the foundation of genera, we should reach that point towards which modern classification for a long time has been tending in this family as in others, viz. the identification in most cases of genus and species; for all these features unite in the most multifarious manner, constantly appearing in new cross combinations. In the following synoptical table of the Danish species these characters are therefore considered subordinate, and only used for the classification of species within the boundaries of the different genera. These latter are founded on other characters, which have been explained in all essential points in the preceding chapters, so that but little remains to be added here.

That Sternoxi exhibit similar differences in the composition of the sockets of the middle pair of coxæ to those observed in Carabidæ has been noticed in an earlier treatise*. Since then,

* Proc. Royal Soc. of Copenhag. 1855, p. 360. See Ann. & Mag. Nat. Hist. ser. 3. vol. x. pp. 377–379.

Thomson has shown with much ability the details of this point of structure in Elateridæ.

Throughout the whole series up to *Campylus* the ventral surface of the abdomen retains the same peculiarities, being horny, hard, arched, with sharp edges, and so composed that only the last segment is moveable—a circumstance which, even in dried specimens, is distinguishable by the fact that the membrane between the last two segments is bare. In *Campylus,* however, the ventral surface is flatter and softer, particularly along the side edges, where it is almost quite soft, and all the segments are moveable. This is in itself an indication of the power of clicking having in *Campylus* become a subordinate point, as in Melasini and Eucnemidini, though there it is due to a development of the type in an entirely opposite direction; for whilst in *Campylus* the faculty of springing yields the first place to the development of the legs, it is in the two groups just mentioned the power of flight which is increased at the cost of the "clicking." But in *Campylus* we meet also with another important circumstance—namely, that the elytra do not, as in other genera of this family, fit into a groove on the pronotum, but protrude freely above its posterior edge. Amongst the digging Elateridæ or Cebrionini this arrangement is only met with in *Cebrio.* The preponderance which, in conformity with this, is accorded to the legs, shows itself in several peculiarities—for instance, in this, that the fore legs cannot, as in other Elateridæ, be accommodated inside the hind corners of the pronotum, which therefore are continued backwards in the form of a spout. These remarkable and important peculiarities in the structure of *Campylus* have hitherto been overlooked; and thus it has not only been classed together with such genera as *Hemiops* and *Plectrosternus,* with which it has in reality nothing to do, but authors have even placed in the genus *Campylus* itself such species as *E. homalismus,* Illig., and others, which do not resemble *C. linearis* or *C. denticollis* in anything except in general outline and habitus, but entirely differ from them in the structure of the sternum, limbs, and abdomen, and therefore must find their proper places in other genera of Elateridæ.

Besides *Campylus* there is one other Danish genus of this family in which the pronotum is not arranged for receiving the base of the elytra in its hind margin, and in which, therefore, in like manner the springing-joint is without the essential support afforded by this articulation. *Campylus* shows by its whole structure that this want is connected with a reduction of the springing-faculty in all points, and an increased development of the limbs. We might therefore at first sight be surprised to find the same want of support in the articulation in a genus

including some of the most powerful springing beetles, namely *Cryptohypnus* (circumscribed in the manner indicated below). It is, however, clear that what is lost in firmness is gained in freedom of movement, inasmuch as the articulation thus modified allows the animal to stretch the prosternum much further back. We observe also that this bold feature in the structure of *Cryptohypnus* is combined with and compensated by the highest development of everything else which contributes to the springing-process, such as the long prothorax, elytra with raised ribs, &c., the small size (2 lines) of the animal being also an important element in this respect. No doubt this immense development of the springing-apparatus is calculated to suit the habits of the animal, because, living in sandy soil, they cannot depend either on firm support for the body in springing, or on a firm footing while running. In such localities these small "clickers" skip with such power (nearly a foot in height), with such rapidity, and so many times consecutively, that it is often difficult to catch them.

[To be continued.]

XXX.—*On the Homologies of the Male and Female Flowers of Conifers.* By Andrew Murray, F.L.S.

[Plate X.]

Notwithstanding the numerous analyses to which the flowers of Conifers have been subjected, the opinion of botanists regarding the significance of their parts is by no means unanimous. Any additional light upon the subject should therefore be welcome.

The hot and long continued summer of 1865 seems, by ripening the wood, to have induced a more plentiful flowering of Conifers this year than usual—many species which had not previously flowered, or at least not previously produced male flowers, having done so this summer. The study of some of these has presented the relations of the different parts to me in a clearer light than any in which I have hitherto seen them placed; and I venture to submit them to the reader in the hope that I may thus contribute to the clearing up of the difficulties which surround them.

If we take the male catkin of any Cypressine Conifer, say *Wellingtonia*, which is one of those which have produced male flowers in Britain for the first time this year, we find that it consists of a few scales (Pl. X. fig. 1), with small rounded balls peeping out between them. These scales are obviously a mere continuation of the scales of the branch; but on examining them minutely,

we find that they are a little larger and broader, their margins somewhat laciniated instead of being smooth, their colour, instead of being green, yellowish fawn or pale brown, and their texture, more especially at the margins, petaloid. It is often difficult to tell whether an organ is a petal, a sepal, a bract, or a leaf; but, speaking in a general way, there are two characters which are rarely absent from petals, and help to distinguish them: one of these is colour, and the other a peculiar elongated cell-structure which does not, indeed, essentially differ from other cell-structures, but which has a different aspect and is easily recognized. We all know the texture of a petal; and where that texture is present, either in whole or in part, it furnishes a presumption that the organ possessing it is a petal. In Conifers it often suggests the fact at once where, but for it, the petaloid nature of the part could only be determined in some more roundabout and difficult way. For instance, in *Cunninghamia Sinensis,* where what is called the scale (but what in that particular instance is the petal) is, as plainly as can be, a continuation of the hard leaves of the branch, and, bearing stomata, traces of the petaloid structure will be found in the laciniated margin. So in *Wellingtonia* and all the Cypresses, the scales which form the male catkin, although merely the continuation of the leaves of the branch, are the petals, each petal being one flower, and the small rounded balls which peep out at their base are the anthers; these are sessile and grow at, along, or on the inferior margin of the petal, as shown in Pl. X. figs. 2 & 3. Of course it makes no difference physiologically whether they are sessile or grow upon longer or shorter filaments or foot-stalks. At first they grow facing inwards towards the axis; but by-and-by, probably from there not being sufficient space there, they are turned backwards, as shown in fig. 4. I should here observe that figs. 2 and 4 are respectively of *Wellingtonia* and *Sequoia sempervirens* (the flowers of which correspond in all respects), the former being what I observed first in *Wellingtonia,* and the latter what I saw at a somewhat later date in *S. sempervirens.* I have no doubt that if I had had the opportunity of observing *Wellingtonia* at the same later date, I should have found the anthers reverted as in the other, or that if I had thought of examining *S. sempervirens* at the earlier date, I should then have found the anthers facing as in fig. 2.

In firs and pines exactly the same arrangement subsists: the male flower assumes the form of fig. 5 when young, and of fig. 6 when full-grown and the anthers have burst and the pollen been shed. Fig. 7 shows the underside before it has burst; and the longitudinal line on each anther shows where it bursts, having previously thinned off, perhaps through having been rubbed by

resting on that point against the upperside of the next anther. It will be seen how exactly the male flower when young (fig. 8) corresponds with the flower of *Sequoia sempervirens* and *Wellingtonia*. The petal in *Sequoia* is larger and of a stronger consistence, and its anthers are rounder and comparatively smaller; but the chief difference is that, in the firs and pines, the anthers on each side, although still sessile, have extended themselves backwards, and united to the flower-stalk, which has become more elongated. The petal is now called the crest of the anther, and its back is now spoken of as its front, the more prominent and more highly coloured side being exposed outwards; but the same arrangements remain as in the Cypresses. The petal or crest of the anther is more highly petaloid in structure than in the Cypresses, and its colour is usually more bright and rich; but, as in them, it is concave towards the axis and convex on the outer side. The stamens are sessile as before, and attached to the inferior margin of the petal; but the union is continued down the peduncle, which is comparatively longer; that is all the difference.

With the key thus given, it is impossible to misunderstand the homologies of the male flowers: they are monopetalous and diandrous in the firs and pines, monopetalous and polyandrous in the Cypresses and allied genera.

The female flower is also monopetalous. In the young state the petal is a small bract, sometimes green, sometimes even more richly coloured than the petal of the male flower, but always petaloid in texture, at least at the margins. Various authors have, from considerations of development and analogy, surmised the identity of this bract with the stamens in the male flower; but this is rather more than the truth. It is not with the stamens that they correspond, but solely with the crest which surmounts them, or, rather, from the base of which they spring. As it appears to me, it has no analogy, affinity, or homology either with the anthers or their peduncle.

This petal or bract is always present, so far as I have seen, although in the mature cone it is sometimes difficult to distinguish it. It is developed to the greatest extent in some of the silver firs, as *Picea bracteata* and *P. nobilis*. In the mature cedar it may be wholly overlooked, it having in it, by the pressure of the seed behind it, been reduced to a mere pale ragged scurf, interrupted in the middle. In the Cypresses it is often reduced to a mere membrane or crust. If we open a young green cone of *Wellingtonia* or *Sequoia sempervirens*, we see the space between the scales filled with a bright claret-coloured matter which looks like an exudation, fitting into the sinuosities of the scales. This is the petal; and if examined with a lens,

the petaloid texture is very obvious: when the cone is mature, the petal has been converted into a film or crust. In the pines the petal takes the form of a small stiff bract, which in some is very plain in the mature cone, in others less so, or more or less squeezed or obliterated by the pressure of the surrounding scales.

Another evidence that this bract is the petal is the fact that, as in other flowers, it appears first, and remains for a short time before the seeds or their envelopes begin to show themselves. It is, no doubt, persistent both in the male and female flowers; but we have plenty of other flowers with persistent petals; and although it does not fall off at the same stage as in most other flowers, we can estimate the termination of its flowering by the appearance of the parts connected with the fructification inside of it.

In other plants the seeds are developed within the petal or petals, and their envelopes take their place in a determinate order or series of concentric layers. That order, I think, is preserved in the Conifers; and I shall first contrast the layers or envelopes which encircle the seed in ordinary dicotyledonous plants with what I consider the same parts in Conifers, and then take each of the parts separately and endeavour to show that they are what I suppose them to be. The envelopes, beginning with the petal and looking inwards, then, are as follows:—

	In ordinary dicotyledonous plants.	In Conifers.
1. Outermost envelope or its appendages.	Petal.	Bract.
2. Next envelope.	Disk.	Scale.
3. First covering of fruit.	Pericarp.	Wing of seed.
4. Second ditto.	Mesocarp.	Cellular substance between 3 and 5.
5. Third ditto.	Endocarp.	Testa.

The remaining envelopes of the nucleus of the ovule in the Conifers (primine, secundine, &c.) in no respect differ in appearance or function from those of other seeds, and therefore need not be specially noticed.

An examination of the above parts shows nothing inconsistent with the above distribution of function which I have assigned to those of the Conifers.

1. *The Scale.*

As with the stamens growing on the inferior margin of the male petal, the ovary takes its rise on the inferior margin of the female petal. Physiologically, perhaps its ultimate origin is to be referred further back; but this is the point where it comes

into view. Its first appearance and subsequent growth have recently been fully traced by various physiologists; and I need not recapitulate their observations. I refer the reader to Payer's observations, Baillon's paper in the 'Annales des Sciences,' to Dr. Dickson's translation of a part of it and to his own observations on *Dammara* and *Araucaria* in the Transactions of the Botanical Society of Edinburgh, for details on the growth and development of the ovary.

Figure 18, copied from one of Baillon's figures of the germ in its earliest state, shows its appearance when the wing begins to manifest itself. The bract lies behind the scale, its margin being just visible over the top of it. The position and appearance of the germ at this stage is, to my mind, proof that it is equivalent to the pistil. The two ears are the commencement of the pistil.

Prof. Caspary, in a paper in the 'Natural Hist. Rev.' (1862), expresses his dissent from Baillon's observations. He has made similar investigations on allied species, and not got the same results. He found, in the larch, that what Baillon calls the ovule appeared first "in the shape of a hemispherical boss, around which, some weeks later, the integument is produced, not in the form of two distinct horseshoes, but of a complete ring, uniform in height all round;" and therefore he held that it was the nucleus of the seed, and that what becomes the wing was one of the integuments of the ovule. *So it is*, no doubt; but it is the outer integument of the ovule—that is, the pistil or pericarp. All the other integuments can be traced within. I rather look upon Caspary's objection as affecting the question whether the wing &c. is a converted dicarpellary leaf or a converted single carpellary leaf than whether it is a carpel at all.

I may, however, say one word in support of Payer and Baillon's observations. Founding on his observation on the larch, Prof. Caspary says, "As it is incredible that the integument of *Pinus Larix* should from the first be a regular ring, while that of the other Conifers examined by M. Baillon presents in its earliest condition the appearance of two horseshoes, the observations of MM. Baillon and Payer appear to me more than doubtful." But it is not alone the observations of Payer or of Baillon, nor the confirmation of them by Dr. Dickson, that would require to be set aside; the very same thing was seen and figured by the older writers. Lambert figures it very distinctly, in his genus *Pinus*, as present in the cedar, and so does Richard in his monograph 'De Coniferis, &c.;' and as he also figures different modifications of it, we may be allowed to hope that the different appearances are not so irreconcilable as Prof. Caspary supposes.

I think I find an unintentional and indirect support of the

view I have taken of the nature of the scale in one of the results announced by Baillon. No doubt we differ in some respects. He holds, and so do I, that the fructification of Conifers is not gymnospermatous, but that it possesses a true dicarpellary ovary; but he holds also that it is without floral envelopes, in which, as already said, I do not agree. But the inference he arrived at which has most interest to me is, that "the cupule, of various consistence and form, which surrounds the ovary, and which in several genera has received the name of aril, is a later production, although anterior to fecundation, as is the case in those floral organs (resulting from an ulterior expansion of the axis) *which have been termed disks.*"

This seems to mean that the cupule of the yew is a disk. I so hold it, and regard it as the homologue of the scale in the pines; only, the flower being here solitary, the seed is wholly surrounded by the disk, instead of, as in the pine (where it is not solitary), being confined to one side, its place on the other being supplied by the back of the next disk, on which it leans. If Baillon also meant to include the scale of the pines under the term cupule, then he has anticipated me in the view which I now propound, and I must content myself with the ejaculation "Pereant qui ante nos nostra dixerunt." But I think I may (indeed, in the interest of the hypothesis, I *ought* to) state that my view is neither borrowed nor adapted from that of Baillon: I arrived at it by the route I have above pointed out; and it was only on turning back to Baillon's paper, in order to verify my statement of his other views, for the purpose of this paper, that I noticed the bearing of the passage above quoted.

Thus arrived at by independent minds, and by a different course of reasoning, the probability of its being the true solution is materially strengthened.

If, then, the bract is the petal and the wing of the seed the pistil, what is the scale? It cannot be the pericarp (which is the most tempting and natural-looking idea), because the pericarp must necessarily be one of the coats of the pistil. There is only one thing that it can be; and that is, the disk. The definition of a disk is, that it is whatever intervenes between the stamens and the pistil. To be sure, we have no stamens here; but we know very well where they should be if the flower were hermaphrodite, viz. springing from the base of the bract behind the scale; so that by no contrivance could they come between the scale and the germ growing on its base.

The scale must therefore be the disk. That organ assumes great variety of form, such as scales, hairs, glands, petaloid appendages; but that form which seems most parallel to the present case is the inner lining of the hip of the rose. In fact the fruit of the Conifer

is a hip whose disk, instead of enclosing the seed all round, lies, like the petal, only on one side; and the reason is plain. Nature sets us all an example of economy. If she were about to build a house, and the gable of another house would serve for one of its walls, she would never be at the wasteful expenditure of building a second wall parallel to it, but would use the old gable to save space and expense. She has done so in the Conifers; she has built her wall of disk leaning on the back of the next disk, making its back wall serve for the front of her house, as shown in the section (fig. 17).

The same one-sided arrangement follows into the seed; but there it appears to be the result of its position and the physical or mechanical consequences of the growth of the parts about it. At first a mere rounded carpel with the apex of the pistil looking downwards, it is soon compressed and flattened by the growth of the scale outside of it and of the neighbouring scale inside of it, and the epicarp dragged forward or pushed up (or, what is the same thing, the growth is inclined in that direction) so as to form the wing; and this in most cases is carried on until it has left the endocarp itself bare on the inner side, and sometimes partially and at others wholly bare on the outer side too.

Looking at the scale in the above light, it may be desirable to note one or two points in its structure and development which, I think, have been overlooked. Not that they perhaps have any bearing upon the question of its being a disk, but merely to make a jotting of the facts.

In pines and those Conifers which have an exposed apophysis and mucro, the first part of the scale which appears is the mucro of the apophysis. Fig. 9 shows the young female cone of *Wellingtonia* much magnified; and figs 10 and 11 represent an individual scale seen from the exterior and sideways, with the young seeds hanging from it on the inner side. At this stage it is very apt to deceive the observer as to its homology, seeing that it is not much larger than the male petal, and, like it, apparently a continuation of the scale-like leaves of the branch: one's first idea naturally is that it is the homologue of the male petal; but on examination, besides finding the true claret-coloured petal behind it, we fail to perceive the petaloid texture at the margin; the margin is not laciniated, and the texture is the ordinary cell-texture of the leaf.

The subsequent growth of the scale is chiefly from the base. This is the case with leaves too. The point of a leaf never increases much in size; it is the middle or posterior half where the chief growth takes place. In the male flower we have seen that it is the peduncle which elongates, increasing and extending the dimensions of the anther with it, but carrying on the

petal or crest of the anther at its extremity without materially adding to its size; so the same process of growth takes place here. The apex of the scale is pushed on by the growth of the lower part of the scale, and its shoulders are filled out and distended, by the accumulation of cell-growth behind them, until they assume the form of a mature apophysis. It is in consequence of the growth of the scale taking place in this manner that in some Conifers, as the firs and pines, we have the seeds growing upright in an orthotropal manner from the base of the scale, while in others, as *Wellingtonia* and *Sciadopitys*, they hang down from the upper part of the scale. The point of insertion of the seeds is obviously close upon the boundary line where the growth of the scale commences to act with vigour. If it be below it, the seeds grow upwards, being determined in that direction by their base or foundation being as it were pushed downwards, and the body of the scale, by its lengthening upwards, giving an inclination to the seed resting on it to follow in its growth the same direction. If the insertion, on the other hand, is above the point of growth, their base, being attached to the body of the scale, is carried upwards with it, and their apex is turned downwards by the upward growth of their point of insertion, as, indeed, they could not well grow in any other direction. If I am right in this interpretation of the cause of the seeds in some species growing up, and in others growing down, it deprives that fact of much of the significance which systematists have sought to attach to it.

The growth of the scale is strengthened in the interior by a woody core; but here, too, its appearance is very apt to mislead us. Figs. 12 and 13 represent respectively the core of a scale of *Wellingtonia* and of a fir. It has a strong resemblance to the flat branches which we often see in distorted shoots of the spruce fir, where two or three twigs have become united; and hence many observers have adopted the view that the scale was only a converted branch: but every part of a plant is only a phase of another, all being referable to some modification of a leaf; therefore the analogy to be drawn from its branch-like core is no ground for holding the scale to be analogous to a branch. The same objection would apply to all pericarps having a woody core.

It is to be observed, too, that although in the pines and spruce firs this core remains, like a branch, and does not fall off like most other pericarps, in the silver firs it does become constricted at the base and drops off as they do.

The core is double, as is well shown in Richard's figures; but while apparently a double central stem, each of which we should expect to supply respectively the inner and outer halves

of the scale, it is in reality allotted wholly to the inner half of the scale. Fig. 14 shows the apophysis of the scale in *Wellingtonia,* fig. 15 a section of a scale taken from a mature cone of that species, and fig. 16 a section of a scale of *Pinus patula*; and it will be seen that the posterior ligneous plate in both cuts in with rather an abrupt turn just behind the mucro. It would appear therefore as if the greater strength was apportioned to the inner portion of the structure rather than to the outer, which is just what we find in other nuts, such as the cocoa-nut, &c.

2. *The Wing and Envelopes of the Seed.*

I assume, then, as a fact already proved, that the covering of the seed of which the wing is part is the carpel. In discriminating its different parts, the only difficulty is with regard to the mesocarp. The testa is, of course, the endocarp, equivalent to the stone of the peach or to the pip of the cherry. The wing is equally, of course, part of the epicarp. It is double, and, as already said, usually covers one side of the seed entirely, and more or less of the other side. In the firs, and especially the silver firs, it is folded like a sheet triangularly round the seed, leaving a portion at each end more or less exposed. There is, however, not much mesocarp; but if the wing in some species be cut across immediately above the seed, a moderate thickness of cellular substance will be found there. This I consider the mesocarp, which thins off on either side.

Within the carpel are found, in Conifers as in other plants, the ovule, consisting of a nucleus enclosed in its two coverings, the primine (the outer) and the secundine (the inner), as difficult to distinguish as in other plants, but not more so; and the tercine, quartine, and quintine of Mirbel, representing respectively the albumen of the cotyledons, the circumvolution of the embryo-sac, and the embryo-sac itself, are, of course, there too.

There remains to say one word, and only one, upon the corpuscles in the ovule. It appears to me that their significance has not been fully apprehended. The corpuscles or embryo-sacs, rightly taken, are the young cotyledons; and to say that an ovule has only two cotyledons is merely saying in other words that it has only one embryo-sac; or to say that it is polycotyledonous, is equivalent to telling us that it has corpuscles in the ovule. Brown says upon this point, "that each of these opaque bodies terminating the trunk and branches of the funiculi are really rudimentary embryos, is proved by tracing them from their absolutely simple state to that in which the divisions of the lower extremity become visible, *and those again into the perfect cotyledon.*"

This, therefore, is a character of the Gymnospermata which must be withdrawn by those who wish to retain *Gnetum*, *Ephedra*, or *Welwitschia* in the same group as the Conifers and Cycads. I do not; but to give my reasons for that would be to open another phase of the subject, which it is not my intention to enter upon here.

XXXI.—*On Green Oysters.* By ARTHUR W. E. O'SHAUGHNESSY, of the British Museum.

PLINY tells us of red oysters being found in Spain, of others of a tawny hue in Illyricum, and of black ones at Circeii, the latter being, he says, black both in meat and shell. Moreover these black oysters seem to have borne the palm of excellence in ancient times, being mentioned by various writers, amongst whom we may cite Horace; and, in spite of Mucianus, who tries hard to puff the oysters of Cyzicus as "larger than those of Lake Lucrinus, fresher than those of the British coasts, sweeter than those of Medullæ, more tasty than those of Ephesus, more plump than those of Lucus, less slimy than those of Coryphas, more delicate than those of Istria, and whiter than those of Circeii," Pliny records it as an ascertained fact that there were no oysters fresher or more delicate than those of Circeii. So much for *black* oysters, which we have never seen, and do not wish to deal with at present. Green oysters seem to be a more modern invention, and, as far as we can learn, are in many cases thoroughbred "young natives"—that is, *Britishers*, which appear to have made a rather unfavourable impression on the palates of our neighbours across the channel.

Some time ago a considerable excitement was created in France by the story of certain luckless individuals, who, having eaten of poisonous green oysters in the market at Rochefort, suffered accordingly. Upon inquiry, it was found that these oysters came from Marennes, on the west coast of France. Now Marennes has long been famous for green oysters; but, by the united exertions of the mayor of Marennes and his secretary, M. Bourricaud, the fact was elicited that *poisonous* green oysters came from Falmouth, in Cornwall. In a letter to the 'Moniteur,' on this subject, M. Bourricaud showed how "the enormously increased demand for the green oysters of Marennes, so justly renowned for their delicacy, had rendered the oyster-banks of that coast insufficient to supply the beds"—how, under these circumstances, it had become necessary to have recourse to Spain, Brittany, England, and Ireland—and how the young natives from Falmouth were not deemed presentable until they

had been subjected to about six months sojourn in the company of their French brethren. Coming, after this prefatory information, to the case in point, he related how a certain tradesman, actuated by the lawless desire of premature aggrandizement, had been guilty of selling, in the market of Rochefort, oysters from Falmouth which had remained only three weeks in the French beds. By a prompt analysis of the remaining individuals belonging to this poisonous batch of oysters, made by M. Cuzent, it was found that an average of "23 centigrammes (about 3½ grains) of salt of copper was yielded by a dozen of these oysters"—a dose which, as M. Crosse remarks, in the 'Journal de Conchyliologie,' is more than sufficient to account for the evil effects which are said to have manifested themselves.

The presence of so extraordinary a product as copper in these oysters was soon accounted for by the discovery that the part of the Bay of Falmouth whence they were brought was in the immediate vicinity of a mine of copper then in process of working. The waters which continually washed the bank, being strongly impregnated with salts of copper, communicated a similar seasoning to the oysters, which, thanks to their obtuseness of organization, seem to have been very little affected by it themselves, and to have become in some sort acclimatized.

Very different, however, was the effect produced on the unsuspecting dupes of the Rochefort merchant. According to all accounts, it would appear to have been a veritable case of poisoning, although, we believe, fatal consequences were averted; and, in spite of the assurances of M. Bourricaud, that a "complete poisoning" by means of these oysters would be impossible, we agree with the editor of the 'Journal de Conchyliologie' that an *incomplete* one is a sufficiently disagreeable affair.

In order to ascertain the presence of copper in the oyster, M. Cuzent recommends that a sufficient quantity of pure ammonia be poured upon the flesh, which will soon declare its poisonous qualities by assuming the dark-blue tint which distinguishes ammoniacal salts of copper. Another method is to plunge a sewing-needle into the green parts of the oyster, and immerse it so transfixed in vinegar. In a few seconds the parts of the needle in contact with the flesh will become covered with a coating of red copper reduced to the metallic state. It appears that an oyster in which the green tint is peculiarly clear is especially to be avoided, while those which are of a bluish green colour are not only fit to eat, but are considered very choice.

Now the green tint frequently observable in the oyster has attracted the attention of scientific men from time to time, long before the serious occurrences just mentioned, which took place in the spring of 1862; and it would seem that, in nearly all the

cases on record in which fatal consequences have followed their use as an article of food, there is reason to suspect that copper has been the chief cause of the evil.

So far back as the year 1713, mention is made of a certain luxurious supper given by an ambassador at the Hague, who, in order that no delicacies might be wanting, procured green oysters from England. All who eat of them are said to have been immediately seized with severe colics, and to have been cured with great difficulty. Lentilius, on whose authority this account rests, states that it was afterwards ascertained that the merchant, whom he anathematizes with his whole race, had palmed upon the ambassador some common oysters tinted with copper, for the true greens*.

Another case is recorded by Dr. Chisholm in the 'Edinburgh Medical and Surgical Journal,' vol. iv. p. 400. He was informed by Mr. William Newton, of St. Croix, that some time after the British frigate 'Santa Monica' was cast away on the coast of the island of St. John (one of the Virgin Islands), oysters grew on her bottom, which was coppered. Many people ate of these oysters; and although the consequence was in no case fatal, it was dangerous and unpleasant in a very great degree, producing cholera and excruciating tormina.

With regard to those oysters in which the green tint is not due to any such deleterious cause, but, on the contrary, rather enhances their value as a delicacy, many very different explanations have been offered of the manner in which that colour is acquired. It has been said that the water in the artificial beds, remaining stagnant in warm weather, becomes green, and soon communicates the same colour to the oysters themselves; and Dr. Johnston, speaking of the French oysters, says that, in order to communicate to them a green colour, which, as with us, enhances their value in the market and in the estimation of the epicure, they are placed for a time in tanks or "parks," formed in particular places near high-water mark, and into which the sea can be admitted at pleasure by means of sluices; the water being kept shallow and left at rest is favourable to the growth of the green Confervæ and Ulvæ; and with these there are generated at the same time innumerable minute crustaceous animalcules which serve the oysters for food, and tincture their flesh with the desirable hue.

In 1820 M. Benjamin Gaillon made a series of observations upon this subject, which he communicated to the Académie des Sciences de Rouen, and which led him to the conclusion that the green colour of oysters is due to the absorption of microscopic animalcules allied to the *Vibrio tripunctatus* of Müller,

* Dr. Johnston's 'Introduction to Conchology,' p. 19.

for which he proposed the name of *Vibrio ostrearius.* These creatures he described as gelatinous, linear in shape, pointed at the extremities, rounded in the middle, being also contractile in that part, and charged with a quantity of green fluid. He says that they inhabit the water of the tanks or "parks" in which the oysters are preserved, in such immense abundance at certain periods of the year that they can only be compared to the grains of dust which rise in clouds and obscure the air in dusty weather.

In a *résumé* of his observations on this subject which he contributed to the 'Journal de Physique,' tome xci. (1820) p. 222, he observes that the change of colour takes place only in the "parks" or reservoirs of salt water, where the oysters are kept on being brought from the sea. These "parks," which are about 4 feet in depth, 200 to 250 feet in length by about 50 feet in breadth, are capable of containing from 500,000 to 600,000 oysters: such are those of Marennes, Oléron, Courseulles, Caen, Havre, Dieppe, Tréport, &c. At certain seasons of the year, particularly from April to June, and again in September, the water becomes, in some of these reservoirs, of a dark-green tint; even the small stones at the bottom of the tanks are covered with small green points or excrescences. Then, says M. Gaillon, the oysters which are destined to assume the same colour are placed, with great care, one by one, and side by side, in order that none may rest upon any of the others, and the supply of fresh currents of water is suspended for a longer or shorter period, according to the required intensity of the green.

M. Gaillon rejects the supposition that the change of colour is the result of disease, on the ground that, having compared the green oysters with those of the normal tint, he found all the organs quite as healthy in the former as in the latter.

To the opinion which has often been entertained, that the green colour is due to the numerous minute particles of marine plants which either themselves form the food of the oyster or communicate their colour to the water absorbed by it, he objects that the plants which most commonly find their way into the reservoirs are the *Ulva compressa* and the *Conferva littoralis,* which are known to turn yellow with age, and which, if macerated and left for several days in jars of salt or even fresh water, will not communicate the least tint of green to the fluid, whereas both the mouth and stomach of the oyster are totally unfitted for such food as Ulvæ or Confervæ.

By the aid of the microscope, M. Gaillon discovered that the little green excrescences with which the stones at the bottom of the tank were constantly studded were nothing more than a heap of the tiny animalcules which filled the water in myriads,

and which, when thus collected together in a lump, became visible to the naked eye. He says that, on placing a drop of the water under the microscope, he perceived thousands of Vibrios sporting about with every possible kind of motion—sometimes with a sudden jerk or impulsion forwards or backwards, sometimes spinning round on their own axis like the needle of a compass, sometimes standing straight up on one end, or darting off with astonishing velocity at some other animalcule, and sticking one of their pointed extremities into him as if it were a lance.

That the green colour which makes its appearance in the oyster is really due to the absorption of these living atoms, M. Gaillon has expressed his firm conviction, both in the 'Journal de Physique' above cited, and in the 'Memoirs of the Linnæan Society of Calvados.' He assures us that as soon as the fresh water is again allowed to have free access to the reservoir the oysters gradually lose both the green hue and the altered flavour which accompanies it, although they are sometimes so thoroughly impregnated with the green matter that they do not quite lose it even in the winter, consequently long after the disappearance of the Vibrios; there is, however, a gradual and sensible diminution in the tint. It is this duration of the green colour so long after the animalcules have ceased to exist, says M. Gaillon, which accounts for the assertion that green oysters may be obtained all the year round; those, he observes, who have never witnessed the intensity of the colour at certain seasons of the year would probably designate as green oysters any which showed the faintest remnant of that tint.

According to all observers, it is the region of the branchiæ or gills which exhibits this peculiarity the most strikingly. Now M. Gaillon assures us, from having examined these organs with the microscope, and compared the orifices of the tubular filaments with the size of the animalcules, that the latter could not possibly enter the system of the oyster in that region.

Perhaps one of the most significant facts recorded by M. Gaillon as the result of his laborious observations is, that at different seasons of the year the water of the oyster-"parks" presents very different tints, being sometimes brown, at others green or yellow—both the brown and the yellow being equally the result of the abundant presence of microscopical animalcules of a different species from the green *Vibrio ostrearius.* The brown species, we are told, has as striking an effect on the colour of the oyster as the green one, and greatly improves its flavour; whereas the yellow are considered prejudicial.

With reference to these so-called animalcules, we need scarcely state that the atoms hitherto referred to the genus *Vibrio* are

now recognized as being of a vegetable nature. The species *ostrearius* appears in the last edition of Pritchard's work on the Infusoria as a *Navicula.*

In spite of the detailed observations and experiments of M. Gaillon, we find M. Valenciennes remarking, at the commencement of a paper on the same subject at the 'Comptes Rendus de l'Académie des Sciences' for 1841, "On sait combien les explications données jusqu'à ce jour sur la coloration des huîtres laissent encore à désirer." The object of this paper is to prove that the green colour is due to *an animal matter which must be quite distinct from all green organic substances hitherto known.*

M. Valenciennes says that the only externally visible organs which display this colour are the four leaflets of the branchiæ. On lifting the upper part of the mantle, the inner surface of the labial palps alone appear coloured; and on extending the examination to the internal organs, the intestinal canal beyond the stomach is seen to be of a bright green colour; the liver is of a blackish green tint instead of the usual red; but neither the muscles, nerves, heart, nor even the juices of the body exhibit any change of colour.

According to M. Valenciennes, the colouring matter offers nothing remarkable when viewed under the microscope; but when examined chemically it is found to possess certain properties which led him to the conclusion above quoted. His observations were made on the *large green oysters of Marennes*; but he says that like results have followed the application of the same chemical tests to the so-called *green oysters of Ostend,* which are less strongly coloured.

M. Dumas made some experiments in order to discover if the green matter might not owe much of its colour to Prussian blue. The result is stated to have been in the negative. However conclusive the observations of M. Valenciennes may appear, Prof. Bizio, in a memoir read before the Institute of Venice in the year 1845, calls attention to the fact that some ten years previously he demonstrated the existence of copper in the branchial organs of the *Ostrea edulis,* at the time when a similar discovery was made with reference to the spire of the *Murex.* He says that he then hinted at the possibility of the green colour observed in the branchiæ being the effect of the copper which enters into the composition of that organ, and that he has been confirmed in that opinion by these very experiments of M. Valenciennes, which, he says, tend to make it evident, to anybody who knows anything about copper, that the colouring matter is neither more nor less than that metal combined with, and disguised in, the organic substance of the oyster.

It might be somewhat tedious to the reader were we to give

a detailed account of the experiments made by Prof. Bizio with a view to prove this assertion. These experiments, he tells us, were begun in June and continued till the month of September; they appear to have been conducted with great care and precision, and we would refer those anxious to pursue the investigation of this curious and interesting subject at greater length than we have space to do at present to Prof. Bizio's paper, which will be found in the fourth volume of the 'Transactions' of the above-named academy.

Suffice it to say that ammonia, which was one of the principal tests employed by M. Valenciennes in his experiments, is also the agent on which Prof. Bizio most relies; and the results which the latter obtained certainly go to prove that the effects recorded by M. Valenciennes as having been produced by ammonia on the coloured portions of the oyster, were, in part, due to the presence of copper.

It is remarkable that, while M. Valenciennes particularly mentions the presence of the colouring matter in the intestinal canal and liver of the oyster, Prof. Bizio's remarks refer only to the branchiæ. Whether he would imply that the green colour, wherever it shows itself in the oyster, is due to the presence of copper, is a query we are not prepared to answer, but should like very much to have answered for us, as, bearing in mind the cases at Rochefort, we cannot but think this green-oyster question rather a serious one.

Fortunately there appears to be very little call for green oysters in the English markets, and the great bulk of them are, we believe, shipped over to France. Perhaps it is a good thing they are so sparingly appreciated in this country.

It is singular that so little should be definitely known of the cause of a phenomenon which takes place in a creature so easily accessible to observation as the oyster. However, public attention has lately been so frequently drawn to this "illustrious bivalve," that we have no doubt there will soon be some new light thrown upon this subject. We understand that Mr. Frank Buckland, in reply to a question addressed to him by the House of Lords some time since, stated that a professional chemist, to whom he had submitted specimens of the green oyster, had already found out the true cause of the coloration.

This, whatever it be, does not seem, however, to have been as yet made public. Mr. Buckland himself seems to incline to the opinion that a growth of green weed of some kind or other during certain times of the year only is the cause. It is now well known that we have real green oysters, or rather *green-bearded oysters,* in England. These have been long exported to various countries, where the taste for such delicacies was more advanced

than with us. It would seem that the greenness in the oysters from the river Roach in Essex is, however, entirely confined to the beard. The fact that another river (the Crouch), running into the Roach, possesses oysters with *white beards* only renders the whole question all the more curious and puzzling.

Meanwhile, until the actual properties of green oysters which are neither plucked from the keels of ships nor fished up near the copper-mines at Falmouth shall be discovered, we advise any of our readers who are at all inclined to be nervous on the subject to remember the valuable test afforded by ammonia, and add a small bottle of it to the usual pepper and vinegar accessories, to be used in a case of doubt—though, if they have a mind to eat the oyster in case their suspicions should prove groundless, we would recommend the simple ordeal of the sewing-needle as the more suitable.

XXXII.—*Notes on the Skulls of Sea-Bears and Sea-Lions* (Otariadæ) *in the British Museum.* By Dr. J. E. Gray, F.R.S. &c.

The "Prodrome of a Monograph of the Pinnipedes" by Mr. Theodore Gill, wherein he named several genera of this group, and a paper by Dr. Peters on the *Otariæ* in the Berlin Museum, in the 'Monatsbericht' for May of this year, have induced me to re-examine the skulls and skeletons in the British Museum; and I herewith send you the result of my observations. I may observe that Dr. Peters considers all the Eared Seals one genus, but has divided them into seven subgenera, to each of which he gives a distinctive name. Dr. Peters's paper is interesting as determining the specimens described by Pander and D'Alton, Johann Müller, and other German naturalists, as well as describing the more recently received specimens in the Berlin Museum, which certainly is one of the most important on the continent.

Capt. Thomas Musgrave, in a work entitled "Cast away on the Aucklands," 12mo, 1866, pp. 141 and following, gives a very interesting account of the habits and manners of the Lion Seal, showing how unlike they are in their habits to the Seals without ears (Phocidæ). The female brings forth her young far inland, and has to teach them to take to the water which is to be their future home.

Capt. Weddell gives nearly the same account of the habits of the Fur-Seal, as does also Mr. Hamilton (in Ann. & Mag. Nat. Hist. 1839, p. 87).

Unfortunately, having no skull or other parts of the Lion Seal of the Auckland Islands (the most southern of the New-

Zealand group), we are not able to determine whether it is the same species as the *Otaria jubata*, the Sea-Lion of the southern end of the American continent, or whether it is the Sea-Lion of the southern end of the African continent (*Arctocephalus Delalandii*), or the Sea-Lion of the Northern Australian seas (*Neophoca lobatus*).

According to the observations of Dr. Peters, founded on the examination of the typical skulls, *Otaria ursina* of Nilsson and *Otaria Lemarii* of J. Müller (Arch. f. Naturg. 1841, p. 334) include the *Arctocephalus Delalandii* from South Africa and *A. cinereus* of Australia.

Otaria Stelleri of Schlegel (Fauna Japonica, t. 22. f. 55) includes both the Australian Eared Seals, viz. *Arctocephalus cinereus* and *Neophoca lobata*; and it is quite distinct from the *Otaria Stelleri* of Lesson and J. Müller, which is a combination of the Sea-Bear and Sea-Lion of Steller (that is to say, *Eumetopias Stelleri* and *Callorhinus ursinus*).

The males of these animals are described as twice as long and broad (that is, four times as large) as the females. This may explain the difference in size of the skulls from the same localities.

The fur changes its colour as the animal grows, the young being generally black; and the adult males and females also differ considerably in the colour of the fur.

The Eared Seals (Otariadæ) must be considered a distinct family from the Earless Seals (Phocidæ). They have more power of using their limbs like the more typical mammalia, walking on them with the body raised from the ground; they rest with the hind limbs bent forwards. These habits are well shown in Dr. Forster's figures, engraved by Buffon; and they have been verified by the study of the living Eared Seal in the Zoological Gardens. Their scrotum and genital organs are exposed as in the Dog.

The Morse is intermediate between the Eared and the Earless Seals in several particulars. It rests with its hind limbs bent forwards, but it does not use its limbs so freely as the Eared Seals. Some of the older naturalists correctly figured the attitude of the Morse when at rest, as shown in my paper on the figures of that animal (Proc. Zool. Soc. 1853, p. 112). Buffon, misled by the animal-preservers, figures it with the limbs extended behind. Pander and D'Alton represent the animal and the skeleton in their proper position; but they represent the skeleton of the Eared Seal with its hind limbs extended backwards, though the articulating surfaces of the bones of the legs should have shown an anatomist that this is not the natural position in either the Morse or the Eared Seal. Mr. Gould, in his 'Mammalia of

Australia,' erroneously figures Eared Seals with the attitudes of the Earless ones.

I. *The palate produced behind to a line with the condyles. It is deeply concave behind, and becomes deeper as the animal increases in age. The hinder nostril is short, with a truncated front edge.*

1. Otaria, Gray, Gill, and Peters.

Platyrhynchus, F. Cuvier.

Grinders 6/6. In the adult skulls the fourth upper grinder is under the front edge of the orbit, and the sixth or last in a line with the back edge of the zygomatic arch. The hinder edge of the palate is in a line with the condyles, and truncated.

In the skull of the younger animal, about 8 inches long, the hinder edge of the palate is rather in front of the line of the condyles. The upper grinders are also differently disposed: the third upper grinder is under the front edge of the orbit, and the fifth tooth is in a line with the back edge of the zygomatic arch, and the last or sixth tooth is far behind it. The teeth in the younger skull are more lobed than in the adult. This change is remarkable, as the teeth of the young and the adult *Zalophus Gilliespii* are similar in number and position.

Otaria jubata. Southern Sea-Lion.

Phoca jubata, Forster.
Otaria leonina, Péron.
O. chilensis, J. Müller.

Hab. South America, Falkland Islands, Chili.

The oldest of the three adult skulls in the British Museum differs from the other two in the pterygoid processes of the hinder edge of the palate being closer together than in the rest; but this character seems to depend on the greater age of the animal, as it differs slightly in the two other specimens.

In all the younger specimens, varying greatly in size, the pterygoid processes are far apart.

Dr. Peters considers (1) *Platyrhynchus leoninus* of F. Cuvier, (2) *Phoca Byronia* of Blainville, and (3) an adult specimen which is in the Hamburg Museum, and of which he described and figured the skull as *O. Geoffroyia*, to be distinct species.

I cannot see any difference between the skull in the College of Surgeons, on which *Phoca Byronia* was founded, and those in the British Museum; and the figure of the skull described as *Otaria Geoffroyia* is very similar to the skull in the British Museum collection which I have called *O. jubata*.

II. *The palate rather produced behind. The front edge of the hinder nasal opening in a line with the middle of the zygomatic arch.*

A. *The grinders 5/5, the fourth upper (in adult) under the front edge of*

the orbit, and the last in front of the back edge of the zygomatic arch. **Zalophina.**

In the younger skull the grinders are placed rather further back, the hinder part of the upper grinder being behind the back edge of the zygomatic arch. The grinders all single-rooted, as the last or sixth grinder in each jaw, which is generally two-rooted, is absent. The face of the skull is considerably produced, and the forehead is flat.

2. Zalophus, Gill, Peters.

Arctocephalus § *b* **, Gray, Cat. Seals & Whales, p. 55.

Palate concave, narrow in front, wider at the line of the last grinder, and then contracted behind. The hinder nares narrow, elongate, twice as long as wide, acutely arched in front, front edge in a line with the front edge of the orbital process of the malar bone.

Zalophus Gilliespii, Gill.

Otaria Gilliespii, Macbain & Peters.
Arctocephalus Gilliespii, Gray, P. Z. S. 1859, t. 70 (skull).

Hab. California. Brit. Mus.

3. Neophoca.

Arctocephalus § *b* ***, Gray, Cat. Seals & Whales, p. 57.
Otaria, § *Zalophus*, part., Peters.

Palate concave, broad, as broad before as at the hinder part of the tooth-line, then rather suddenly contracted. The hinder nares broad, rather longer than broad, with the front edge broadly arched, which is further back than the front edge of the orbital process of the zygomatic arch, or malar bone, which is thick and flat.

Neophoca lobatus. Australian Hair-Seal.

Arctocephalus lobatus, Gray, Spic. Zool. 1828, t. 4. f. 2 (teeth); Zool. E. & T. Mamm. t. 16, 17. f. 3–5 (skull); Gray, Gould, Mamm. Austr. iii. t. 49; Peters.
Otaria australis, Quoy & Gaim. Astrol. t. 14, 15. f. 3, 4 (skull).
Otaria Stelleri, Schlegel, Abbild. t. 22. f. 1–4.
Arctocephalus australis, Gray, Cat. Seals & Whales, p. 57.

The upper grinders all single-rooted, the root of the two last (the fourth and fifth) being rather compressed, with an obscure central longitudinal groove on the inner side; the two front grinders of the lower jaw with oblong, the three last with compressed roots, and the fourth and fifth with a slight longitudinal central groove on the sides.

In the younger skulls the roots of the grinders are more oblong, less compressed, and do not show the lateral grooves, as far as the teeth can be seen without being drawn from the sockets.

In the front part of the younger skull, which was received from Mr. Gould, the teeth are placed rather further back than in the adult skull from North Australia received from Capt. Grey, the hinder part of the fifth tooth being behind the back edge of the zygomatic arch.

4. ARCTOPHOCA, Peters.

Dr. Peters described this subgenus from a specimen sent from Chili by Dr. Philippi. It chiefly differs from *Zalophus* in the palate being much narrower, but rather wider behind, and the teeth rather far apart. I have not seen any skull agreeing with these characters.

Arctophoca Philippii, Peters, Monatsb. 1866, p. 276, t. 2 A, B, C (skull and teeth).

Hab. Juan Fernandez. Dr. Philippi, Mus. Berlin.

According to the figures, the form of the skull and the large size of the orbit are very similar to those of *Phocarctos Hookeri*; but the number and form of the teeth are different.

B. *The grinders 5/5, the third upper being under the front edge of the orbit, the last or fifth separated from the rest by a broad space and placed far behind the back edge of the zygomatic arch; the hinder grinders two-rooted.*

5. EUMETOPIAS, Gill, Peters.

Arctocephalus § *a****, Gray, Cat. Seals & Whales, p. 51.

Palate flattish or rather concave in front, as wide in front as at the end of the tooth-line, and then slightly narrowed behind. Posterior nares oblong, elongate, broadly truncated in front, the front edge being behind the line of the orbital process of the zygomatic arch. The grinders have large oblong roots; the second, third, and fourth upper ones have a subcentral longitudinal groove on the outer side, and a less marked one on their inner surface; the inner side of all but the first of the lower ones are similarly grooved; the fifth upper grinder (or more properly the sixth in the normal series) has two distinct roots. The lower jaw much more elongate than that of *Otaria jubata*, the hinder angle more oblique, and the lower margin long and straight.

The skull of the young animal, which was sent by Mr. A. S. Taylor to Mr. Gurney from California, and which I first described, with doubt, as *A. Monteriensis*, junior (P. Z. S. 1859, p. 357), and which in the 'Catalogue of Seals and Whales' I named *Arctocephalus Californianus* (see p. 51), agrees in every respect in its dentition with the large skull which we received from California, and which I described and figured as *A. Monteriensis* (P. Z. S. 1859, p. 358, t. 72); but it differs greatly in

the form of the hinder nares, which are extended much more forwards, so that the front end, which is very narrow and acute, is much in front of the prominence of the orbit of the zygomatic arch, being, in fact, about in a line with the middle of the lower edge of the orbital concavity.

This skull is evidently that of a very young animal, for the bones are separate; but it has the same number and disposition of the teeth as the large skull. There is the same wide space between the fourth and fifth upper grinders; but there is at the back edge of the fourth grinder, on the right side of the skull, a small pit, from which, no doubt, a small rudimentary tooth has fallen out; and there is a much wider but shallow pit on the other side, which may have been produced by the loss of a rudimentary tooth; the last upper grinder has a large swollen undivided root. If this is a young skull of *Eumetopias Monteriensis*, that species is curious for having the teeth in the old and young skulls in the same situation as regards the bones of the face.

The adult skull and the young one were from the same locality, and, I believe, collected by the same person; and this being the case, I am inclined to regard them as the same, only showing a curious peculiarity in the growth of the animal, and also showing that the form and position of the hinder nostril probably varies as the animal increases in age.

Eumetopias Stelleri. Northern Sea-Lion or Fur-Seal.

Arctocephalus Monteriensis, Gray, P. Z. S. 1859, t. 72 (skull).
Eumetopias Californiana, Gill.
Otaria Stelleri, Gray; Peters; Müller?
Leo marinus, Steller.
Phoca jubata, Pander & D'Alton, t. 3. f. *d, e, f* (skull, not good).
Phoca Californica et *P. Stelleri*, Fischer.
Lion marin de la Californie, Chloris, Voy. Califor. t. 11.

Hab. California; Behring's Straits.

The Sea-Lion of Steller has been one of the zoological paradoxes. Professor Nilsson, like most preceding authors, regarded it as a variety of the *Otaria jubata*; and therefore I supposed it might be a second species of the restricted genus *Otaria*. Dr. Peters has solved the enigma by uniting it to the Seal which I described from California, observing that the skull in the Berlin Museum, figured by D'Alton under the name of "Steller's Sea-Lion" (*Phoca jubata*), was received from Kamtschatka, and a second skull of an old male in the Berlin Museum was received from M. Brandt as coming from Behring's Straits.

It is to be regretted that these skulls escaped the researches of Professor Nilsson, who visited most museums in Europe to examine the typical specimens.

The specimen of *Callorhinus ursinus*, now in the Museum, was received from St. Petersburg as *Otaria leonina*, or *Leo marinus*

of Steller, from Behring's Straits; so they evidently confound two species under that name.

The figure of Pander and D'Alton is so imperfect that it would have been impossible to determine the species it represents without the examination of the original skull, and then one sees that it might be intended for the species to which it is referred. The same observation is applicable to the figure of the skull of Steller's Sea-Bear.

C. *The grinders 6/5, the third upper under the front edge of the orbit, the fifth and sixth behind the back edge of the zygomatic arch; the upper hinder grinders two-rooted.*

6. Phocarctos, Peters.

Arctocephalus § II., Gray, Proc. Zool. Soc. 1859, p. 109.

The skull elongate, forehead flat. The palate concave, deep, with a thickened margin on each side in front, widest in the middle part of the tooth-line, and gradually narrowed behind the teeth; the internal nares oblong, longer than broad, truncate in front, the front edge in a line with the orbital process of the zygomatic arch. Grinders large, compressed; the fifth and sixth upper behind the back edge of the zygomatic arch. The grinders have compressed roots; some of them have a very indistinct longitudinal groove on the side; the fifth upper grinder has two distinct roots. The ear-bones scarcely prominent, with a flat lower surface.

I have not seen an adult skull of this genus. The skulls described are 10 inches long, but the bones are not knit.

Phocarctos Hookeri, Peters, Monatsb. 1866, p. 262.
The Southern Hair-Seal.

Arctocephalus Hookeri, Gray, Zool. E. & T. t. 14, 15 (skull.)
The *Hair-Seal* of the sealers.

Hab. Falkland Islands and Cape Horn.

The skull of the young animal described and figured by Dr. Burmeister as *Arctocephalus Falklandicus* (Ann. and Mag. N. H. 1866, xviii. p. 99, t. 9. f. 1 & 2) is probably the young skull of this species. It agrees with it in the elongated form of the skull, and in the large size and great development of the processes of the orbits.

Dr. Peters regards the *Otaria Ulloæ* of Von Tschudi (Fauna Peruana, p. 136, t. 3) as a second species of this group. There are two skulls which he refers to it in the Berlin Museum.

7. Callorhinus, Gray, P. Z. S. 1859, p. 359; Peters.

Arctocephalus, Gill!

Skull elongate; forehead rounded in front of the orbit, rather swollen. Palate rather concave, as wide in front as at the end of the tooth-line, rather narrowed behind. The sixth upper

grinder just behind the hinder edge of the zygomatic arch; the grinders moderate, fifth and sixth upper and the fifth lower with two diverging roots.

Callorhinus ursinus, Gray, P. Z. S. 1859, p. 359, t. 58 (skull).
Northern Sea-Bear.

Ursus marinus, Steller.
Phoca ursina, Linn.; Pander & D'Alton, t. 7. f. 1 (not good).
Otaria ursina, Péron; Peters.
O. Kraschenninikowii, Lesson.
O. Stelleri, part., Lesson & Müller.

Hab. Kamtschatka. B. M.

D. *Grinders 6/6, the third upper grinder under the front edge of the orbit, the hinder ones far back behind the back edge of the zygoma.* Arctocephalina.

8. Arctocephalus, F. Cuvier, Peters.

Halarctus, Gill.

The face of the skull elongate; forehead flat. The palate concave, especially in front, with a thickened margin on each side near the teeth, about as wide in front as between the hinder teeth, and then narrowed behind; the internal nasal opening elongate, longer than broad, narrow and arched in front, the edge in a line with the orbital process of the zygomatic arch, which is large and well developed.

In the adult skull of *A. Delalandii* from the Cape the fifth hinder grinder has only very short rounded callous roots, which are slightly divided into two lobes; and the hinder or sixth upper grinder seems to have a root of the same character. But not having any skulls of younger animals, I am not able to describe what are the forms of the root of these two teeth in the younger state.

In the skulls of the other species (which are not adult, as they have the sutures between the bones still distinct), the fifth and sixth upper grinders have two distinct diverging roots.

* *The fifth and sixth upper grinders with two roots* (?); *the sixth upper partly behind the hinder edge of the zygomatic arch.* Arctocephalus. (Africa.)

1. *Arctocephalus Delalandii*, Gray, P. Z. S. 1859, t. 69 (skull).
The Cape Fur-Seal.

Phoca ursina, F. Cuvier, Oss. Foss. t. 219. f. 5.
Arctocephalus ursinus, F. Cuvier.
Otaria ursina, Nilsson.
O. Peronii, Desm.
O. Delalandii, F. Cuvier.
O. pusilla, Peters.
Junior. *Petit Phoque*, Buffon, H. N. xiii. t. 53 = *Phoca pusilla*, Schreb.

Hab. South Africa, Cape of Good Hope.

The two adult skulls in the British Museum differ greatly in the width of the hinder nasal opening, in the form of the hinder lower lateral processes of the occipital bone, in the form of the back of that bone, and in the shape of the condyles.

** *The fourth, fifth, and sixth upper grinders with two distinct diverging roots; the fifth in a line with the hinder edge of the zygomatic arch.* Euotaria. (America.)

2. *Arctocephalus nigrescens*, Gray, Cat. Seals & Whales, p. 52.
The Southern Fur-Seal.

Hab. Falkland Islands?

The two skulls of this species in the British Museum agree in most particulars; but they differ considerably in the form of the hinder nostrils. The larger one is without its upper teeth, but the form of the roots are well exhibited by their sockets; the front edge of the hinder nasal opening is produced rather further forward, and is acutely angular. The other skull, which is rather small and has the teeth in a good condition, has the hinder nasal opening with a slightly arched, nearly truncated, front edge.

Dr. Peters refers *Phoca Falklandica* (Shaw, Zool. i. p. 256) and *Otaria Falklandica* (Hamilton, Ann. & Mag. N. H. 1839, p. 81, t. 4; Jardine, Nat. Lib. vi. p. 271, t. 25) to this species. But as neither Dr. Shaw nor Dr. Hamilton describes the number or position of the teeth, it is not possible to determine if this is the *Fur-Seal* of the sealers, collected at the Falkland Islands, more especially as the fact of the skull coming from the Falkland Islands is not well ascertained. See the other synonyma which have been established on the sealers' descriptions and figures or the skins collected for the furriers at the Falkland Islands (Gray, Cat. of Seals & Whales, pp. 55, 56). Dr. Hamilton, who prides himself on his figure, represents the hind legs as extended behind; but they look very awkward in that position, the stuffer having evidently had a difficulty in extending them.

*** *Fourth, fifth, and sixth upper grinders with two diverging roots; the fifth upper grinder entirely behind the hinder edge of the zygomatic arch. The palate narrow.* Gypsophoca. (Australia.)

3. *Arctocephalus cinereus*, Gray, Cat. Seals & Whales, p. 56.
Australian Fur-Seal.

Otaria cinerea, Péron?; Quoy & Gaimard, Voy. Astrol. p. 89, t. 12, 13, 15 (animal and skull); Peters, Monatsb. 1866, p. 272.
Arctocephalus nigrescens, b & c, Gerrard, Cat. Bones B. M. p. 147.
Black Seal, Otaria, Cat. Sydney Museum, ii. p. 36.

Hab. Australia. John Macgillivray.

Black, greyer beneath; under-fur abundant, reddish brown. There are the stuffed skin, with its skull, and the bones of the

face of another young specimen of this Seal in the British Museum, collected in the Australasian Sea by Mr. John Macgillivray.

The Eared Seals are collected for their oil and skins. Most of the species have very dense under-fur of soft erect hairs between the base of the longer hairs. These are called "Fur-Seals;" and the skins, when deprived of their long hairs, are very valuable. The dressed furs of the various species and localities are of very different commercial and economic value. The skins of *Neophoca lobata* of Australia and *Phocarctos Hookeri* of the Southern Ocean, being destitute of this under-fur, are called *Hair-Seals* by the sealers. Their skins are of little comparative value, as they are only used like the skins of the Earless Seals (Phocidæ).

I have not been able to identify the "Tiger Seal" of Musgrave ('Cast away on the Auckland Islands,' pp. 7, 10, 18, 29, &c.), which seems as abundant as the Sea-Lion of the same locality. They are both probably undescribed.

XXXIII.—*Recent Researches on the Fossil Fishes of Mount Lebanon.* By MM. F. J. Pictet and A. Humbert*.

That the fossil fishes of the coasts of Syria are among those which have been longest known is shown by the mention of them in De Joinville's 'Histoire de Saint-Louis.' This chronicler tells us that, during the sojourn of the Crusaders at Sayette (the ancient Sidon, now *Saïda*), "A certain marvellous stone was brought to the king, in appearance like a quantity of scales, of the which when one was raised you saw beneath, between the two stones, the shape of a fish of the sea. And the fish was of stone, but nothing of its form was wanting, neither eyes, nor fins, nor colour, any more than if it had been living. The king asked for one of these stones, and found a tench in it, of a brown colour and like any other tench."

Various travellers, such as J. Korte, C. Lebrun, Volney, &c., have also mentioned these fishes; but Scheuchzer is the oldest naturalist who, as far as we know, has paid any attention to them. In his work 'Piscium Querulæ et Vindiciæ,' published at Zurich in 1708, we find a passage devoted to the fish figured in Lebrun's 'Voyage' (Cornelius de Bruyn), and another referring to a specimen in the Woodward Collection. The Zurich natu-

* Translated by A. O'Shaughnessy from a separate impression, communicated by the Authors, from the 'Archives des Sciences de la Bibliothèque Universelle,' Geneva, June 1866. See also 'Nouvelles Recherches sur les Poissons Fossiles du Mont Liban,' 1 vol., with plates, by F. J. Pictet and A. Humbert: Geneva, 1866.

ralist, however, teaches us nothing more than his predecessors, as he does not describe these fossils or discuss their zoological affinities. De Blainville was the first to study scientifically some of the Lebanon fishes. He described two species belonging to the genus *Clupea,* and called them *Cl. Beurardi* and *Cl. brevissima.*

De Blainville's essay on the Ichthyolites was soon superseded by the labours of Agassiz in 1833–1843. Nevertheless the learned author of the 'Recherches sur les Poissons Fossiles' possessed actually very slender materials relative to the fauna of Lebanon. He brought to light four new species only, and added some details respecting the two *Clupeæ* described by De Blainville.

In 1845 Sir Philip Grey Egerton described a Ray from the limestones of Hakel; and in 1849 Heckel made known four or five species, brought from Syria by Th. Rotschy. In 1850 one of the present authors published a special memoir on the fishes of the two deposits of Hakel and Sahel Alma, founded upon important materials amassed by MM. E. Boissier and Blondel. In this memoir twenty new species were described.

Since this there has been only one work on the fishes of Lebanon, that of M. O. G. Costa, who has described and figured four new species.

Researches made in 1860 by one of the authors (A. Humbert), in the deposits of the coast of Syria, have greatly enriched the collection of the Museum of Geneva, both in new species and in more perfect examples of such as had been previously described. We have thought it advisable to pass in general review the fishes of Lebanon, completing, whenever we could, the descriptions of the forms already known, and inserting the new species.

We here extract a portion of what we have said in our introduction concerning the age of the two deposits as attested by geological and palæontological evidence; and we also reproduce our general remarks on the two ichthyological faunas of Hakel and Sahel Alma.

Geological data.

The beds which we have been considering are situated on the eastern slope of Lebanon, between Tripoli and Beyrout, nearer, however, to the last-named town. The nature of the rock and the fauna of these two deposits show that they belong to different formations; their age and relative antiquity have, however, not yet been satisfactorily determined.

MM. Agassiz and Heckel, in default of positive information, have done no more than put forward certain hypotheses with respect to the formation to which should be referred the few species which they had within reach.

M. de Tchihatcheff has found at Makrikoi, near the gates of Constantinople, certain fossil fishes identical with those of Hakel. Unfortunately this traveller never saw *in situ* the rock whence the specimens were obtained; and consequently his notices are of little value, except so far as they attest the geographical extension of the beds of Lebanon.

We are consequently almost reduced to the stratigraphical data furnished by M. Botta in his memoir on Libanus and Antilibanus*. M. Botta distinguishes three principal formations in the Lebanon. He refers the lowest of them to the Upper Jurassic period, the following to the Greensand, and the third, which covers this, to the Lower Cretaceous series. The Lower Chalk is composed of an alternation of limestones and calcareous marls. It is in one of the middle beds of this latter formation that the fishes of Hakel occur. With regard to those of Sahel Alma, they belong, according to M. Botta, to the same group, but may be slightly more ancient.

The observations made at Hakel by M. Humbert, although very incomplete, tend to confirm the views of this learned French naturalist. We have, in fact, found fossils characteristically Cenomanian (Upper Greensand), such as *Orca Tailleburgensis*, *Cardium Hillanum*, &c., in layers of alternate limestones and marls, which are immediately overlain by the fish-beds. Possibly, in spite of this superposition, these beds may form part of the same group, and be only a phase of the Cenomanian. A circumstance which would lead us to suppose this to be the case is the fact that in proceeding from the bed of the river to a point situated between the village and the deposit of fishes, and mounting perpendicularly the left flank of the valley, we find a series of calcareous laminæ more or less compact, but without a trace of the fish-bed; the superior laminæ seem, however, to be continuations of those which overlie that bed. We must thence conclude that this latter is superior to the Cenomanian formation, or that it forms part of that formation. If, as we suppose, the *Hippurites lumbricalis* (and perhaps *H. socialis*) obtained between Djebaïl and Hakel are superior to the fishes of Hakel, then these are inferior to the Turonian (Lower White Chalk) formation.

The beds of Hakel would seem to be prolonged over a very considerable space. The *Clupea Beurardi* was described by De Blainville from a specimen brought from Gibel (Djebaïl), and probably emanating from Hakel; M. Agassiz studied a specimen from Saint-Jean d'Acre. The *Clupea brevissima*, so abundant at Hakel, is represented in the Museum of Geneva by specimens

* "Observations on Libanus and Antilibanus," by M. P. E. Botta, jun. (Mém. de la Soc. Géol. de France, tome i., 1st part: Paris, 1833).

labelled as coming from Mount Carmel; M. Agassiz saw in the Zurich Museum a specimen of this species sent from Saint-Jean d'Acre*; Mr. Williamson† found it at Gebel-Suneen (very probably Sannina), near Beyrout; and, finally, as we have just seen, M. de Tchihatcheff has procured it at Makrikoi near Constantinople, where it is associated with *Eurypholis Boisseri* and *Cyclobatis oligodactylus*.

The deposit of Hakel must have been formed at a very slight distance from the land; for our late researches afforded a wingless orthopterous insect.

With regard to the second deposit, we have nothing to add to what Botta has said on the subject, with the aid of certain opportunities for comparison which we have not had at our disposal.

The convent of Sahel Alma, situated 17 or 18 kilometres north of Beyrout, is erected on a sharp declivity which descends to the sea. It is immediately beneath the walls of the convent, in a field of mulberry-trees, and covered solely by the vegetable earth, that the calcareous marl containing the fishes occurs. With them we have collected Crustaceans and two Ammonites. These latter fossils are, unfortunately, not sufficiently preserved to admit of a strict determination.

Valenciennes, in examining the fishes collected at Makrikoi by M. Tchihatcheff, found a species of a new genus, which he named, without, however, describing it, *Strymonia sirica*‡. It comes from a light limestone perfectly identical with that of Sahel Alma, while the other species occur in a limestone very similar to that of Hakel. It would seem, therefore, that the two fish-beds of Lebanon are found also at Constantinople.

Age of the two Ichthyological Faunas of Mount Libanus, according to palæontological data.

We think we are able to establish as almost certain that both these faunas belong to the Cretaceous period. It would be, on special grounds, impossible to attribute them to the Jurassic. The greater number of Teleostean fishes which they afford, together with the absence of Ganoids, show them to be unquestionably posterior to that period.

It seems to us no less evident that they are not Tertiary faunas. For proof we have:—

1. The presence of two species of *Ammonites* in the beds of Sahel Alma, and of an *Aptychus* in those of Hakel.

* It is very possible that Saint-Jean d'Acre and Mount Carmel correspond to one and the same locality.

† Proceed. Geol. Soc. Lond. vol. iii. p. 291.

‡ Bull. de la Soc. Géol. de France, 2e série, 1851, t. viii. p. 301.

2. The existence of a certain number of genera or groups, which, as far as we know at present, characterize the Cretaceous epoch. Such are the genera *Scombroclupea* and *Leptosomus*, the groups of *Dercetis* and *Eurypholis*.

3. The great number of extinct genera which contribute to give these faunas a special physiognomy. These are, at Hakel, *Pseudoberyx*, *Petalopteryx*, *Coccodus*, *Aspidopleurus*, and *Cyclobatis*; and at Sahel Alma, *Pycnosterinx*, *Cheirothrix*, *Rhinellus*, and *Spaniodon*.

4. The fact that among the genera which are still represented by living species, those which are the most abundant at the Lebanon are precisely such as belong also to the Cretaceous epoch. We may mention in particular the type *Beryx*, which is preeminently Cretaceous, although represented at the present day by some species in the warmer seas. We may also cite the *Clupeæ*, the existence of which is demonstrated as far back as the Cretaceous period, and the *Chirocentrites*, the maximum development of which is equally characteristic of that epoch.

The fish which are not referable to one or other of these categories are very few in number, and occupy but a subordinate position in the Lebanon faunas.

But, although we are tolerably certain of the general fact that these faunas are Cretaceous, we find it a much more embarrassing matter to decide to which of the subdivisions of this long age they should properly be referred. The history of fossil fish presents still too many breaks to admit of our applying here the same methods as hold good in the case of Mollusks and Echinoderms, and we are forced to content ourselves with a certain degree of probability.

The first point to determine is that no species of Mount Libanus has ever yet been found in any other deposit, save certain parts of Syria and Asia Minor which belong to the same epoch, and of which we have already spoken. Consequently our comparisons become limited to the more uncertain relations between genera and natural groups.

We have compared the faunas of Lebanon with that of Voirons (as made known by one of the authors*), with that of Comen in Istria (as studied by MM. Heckel, Kner, and Steindachner), with that of the Chalk of England, and finally with that of the Chalk of Westphalia (the numerous species of which have been described in an important memoir by M. von der Marck).

Making allowances for insufficient data, we give the following as the results of these comparisons :—

* F. J. Pictet, 'Paléontologie suisse,' 1858, 1re série. Description des fossiles du terrain néocomien des Voirons.

1. The fauna of Hakel has greatest resemblance to that of Comen in Istria. Nevertheless it presents a greater proportion of living genera, and may thus be concluded to be the more recent of the two.

2. The fauna of Sahel Alma is unquestionably related to that of the Chalk of Westphalia.

3. Both one and the other differ to a greater extent from that of the Chalk of England.

4. These differences and resemblances may be partly owing to geographical causes, and partly to the respective ages of the formations. The former would tend to augment the relations with Comen, and to diminish those with the Chalks of more northern countries, and would consequently weaken considerably the importance to be attached to the resemblances.

In spite of doubts so engendered, the precise limit to which it would be impossible to lay down, our general conclusion is that the faunas of the Lebanon are, both the one and the other, intermediate between those of Istria and those of the Upper Chalk, and that, consequently, their position is most probably in the Middle Cretaceous formation.

And here we have to deal with a question both difficult and embarrassing. What is the relative age of our two Lebanon faunas? And which is the more ancient?

Had the labours of Botta resolved this question, and were we already possessed of sufficient stratigraphical proofs, we should not now be forced to have recourse to the hazard of a palæontological analysis, which is the more embarassing since it leads us to a result quite opposed to that which the above-named author somewhat prematurely regarded as probable. M. Botta believed the fauna of Sahel Alma to be the more ancient. The comparisons which we have lately made, and which have brought us to the conclusion that the fauna of Comen is more nearly related to that of Hakel, while that of Sahel Alma more especially recalls the fauna of the White Chalk, lead us on the contrary to consider the first the more ancient. It is to be hoped that a complete geological survey of these countries will put an end to this uncertainty.

General Palæontological Considerations.

The study of organic development throughout the course of geological time shows that the different classes of the animal kingdom are far from presenting a history uniform in this respect. The epoch, in particular, during which the modifications which have more powerfully affected the organism have taken place would seem to have been by no means the same for the

different classes. We see, at a given moment, a certain class become modified to intensity, while a certain other class preserves its general physiognomy intact, to become subject to a similar process at another period.

The class of fishes is remarkable in this particular*. The last extensive modification it has undergone corresponds to the transition between the Jurassic and Cretaceous periods. Now, with regard to most classes, this transition is relatively of little importance. We see the Jurassic reptiles continuing a great many of their types in the Cretaceous period, whilst the transition between this and the Tertiary period is marked by the most striking changes of form. We see the Mollusks, the Echinoderms, and the Polypes of the cretaceous seas reproducing to a great extent the types of their Jurassic predecessors. If we were to seek the epochs when the greatest modifications in each of these classes have taken place, we should never find them in the interval between the Upper Jurassic and Neocomian periods.

The importance of the change which took place at the termination of the Jurassic period has already been dwelt upon sufficiently by M. Agassiz. Our learned friend has laid stress in particular on the apparition somewhat suddenly at the commencement of the Cretaceous period of the most perfect group of fishes, the Teleostei, which form the large majority of the population of the modern seas. Saving a certain measure of restriction imposed by later researches upon the generality of this assertion, the fact has in the main received every confirmation. It gives a particular importance to the study of the Cretaceous fish-faunas, since these faunas are the origin and, in some measure, the earliest expression of our present existing ones. It is interesting to follow the gradual series of modifications through which they have passed, to note the earliest representative types, the forms which have continued most constant, and those which have been the last to appear. The most generally adopted classification of fishes is that of J. Müller. Of the six subclasses established by him, three have no fossil representatives (*Leptocardii, Cyclostomi,* and *Dipnoi*); the three others alone enter the domain of the palæontologist.

Among these three subclasses, the *Elasmobranchi* retain the same general characters which they have presented throughout all time. This is the group which has undergone the least modification. It is not represented very abundantly at Lebanon;

* Prof. Heer has just called attention to a perfectly similar fact in the history of the vegetable kingdom, 'Les Phyllites crétacés du Nebraska' (Extrait des Mém. de la Soc. helvét. des Sc. Nat. 1866). He has shown that the Upper Cretaceous flora is quite different from the Jurassic flora, and allied rather to the Tertiary flora.

there are, however, the two principal types, Sharks and Rays. These fishes are for the most part difficult of comparison with other fossil species; for, in most deposits, the *Elasmobranchi* are only indicated by isolated teeth: in the Lebanon, however, the case is quite different; there are no isolated teeth, but some few entire bodies.

The subclass of the *Ganoids* is, in all known faunas of the Cretaceous period, in rapid course of extinction. This renders all the more interesting the fact that the faunas of the Upper Jura which immediately preceded this period are rich in numerous and fine characteristic species of this subclass. We have not found at Lebanon any true Ganoid; for we no longer retain in that subclass the order Hoplopleuridæ established by one of ourselves. This order belongs properly to the great series of Teleosteans.

This third subclass is consequently by far the most important. It affords almost the total of the fauna, and it is with it that we have more particularly to deal at present.

As we have said above, M. Agassiz did not place the existence of the Teleostei further back than the Cretaceous period; the greater number of authors now, however, recognize an exception to this rule, and regard as Teleosteans in all probability the genera *Tharsis, Leptolepis*, &c., with minute rounded scales. Taking for granted the correctness of this view, which it would take us too long to discuss here, we have to notice a very important fact, which is that the Teleostean fishes of which M. Agassiz forms his family Halécoïdes, and which we know under the names of *Salmones* and *Clupeæ*, are manifestly the nearest relatives of these same Jurassic genera. The numerous family to which these precious types of our present seas belong are actually the descendants of the Jurassic Teleosteans. They have a history longer than that of any other existing family, and may be regarded as, in some sort, the trunk of the genealogical tree of the fishes of our present seas.

It is, further, very interesting to find that these fishes are the ones which present developed in the highest extent the normal characters of their class, and that they thus in some sort represent the archetype thereof. A theoretical anatomist, wishing to set forth this archetype, would be inevitably led to depict a figure almost exactly like that of a Halecoid, since he would assign to it ventrals in the normal position far back on the abdomen, and a mouth with the edge composed of both maxillary and intermaxillary; and nothing is more normal than the fins of a salmon and its regular and fusiform body.

We may, then, assume that the most ancient Teleostean fishes were the most normal in their forms, and that their cha-

racters were continued in the Cretaceous and following periods by the family of the Halecoids.

Our Lebanon faunas are rich in fishes of this family; for out of fifty-one species now known, nineteen belong to it.

Another important type is that of the Teleostean fishes with serrated scales, united by M. Agassiz under the name of Ctenoids. This denomination, which, at the present day, does not correspond to an order of sufficient zoological value, may, however, still be advantageously employed, in the general comparison in which we are now engaged, to designate all those fish which more or less approach the Perch-type in this serrated form of scale, in the spinous rays of their fins, in the tendency of the bones of the head to develope points, &c.

These fishes, less numerous at the Lebanon than the Halecoids, present, however, as we shall now show, certain very distinct forms; they have, however, a common uniform physiognomy, and resemble each other much more than the recent Ctenoids. Variation set in at a later period, and has gone on constantly augmenting to the present day.

The types of prickly-finned fishes which we find at Mount Libanus are the following:—

1. The group *Beryx*, the singular history of which has already been made known by M. Agassiz. At the present day they form part of a small cluster of genera (*Holocentrum, Myripristis, Beryx*) specially belonging to the Indian seas, allied to the Percoids by their more essential characters, but constituting in that family a tribe characterized by the branchiostegal and ventral rays, which exceed the normal number of seven. This *Beryx*-group, comprising the recent genus and some extinct ones, is the sole representative of the Percoid family during the Cretaceous period. It then existed as the first expression of that family, now so abundant; and after having then constituted it entirely, now exists only as an accessory branch of the same.

2. An interesting and entirely new type, which we have designated *Pseudoberyx*. To the normal characters of *Beryx* it unites that of having the ventrals abdominal—a circumstance of rare occurrence in true prickly-finned fishes. May we not see in this circumstance an indication of a rule similar to that which we have established in the case of the Halecoids, and infer that the first manifestations of types have in general exhibited the tendency to approach the archetypal forms more than the later generations have done?

3. The type of *Pycnosterinx*, already established by Heckel, which in its characters approaches the family Chromidæ, formerly associated partly with the Labroids, partly with the Sciænoids, but subsequently recognized as distinct, and removed to the group

Pharyngognathi. These fishes, in which Heckel discovered pharyngeal teeth, belong to a type at present very distinct from the Percoids; they approach these, however, through the *Beryx* of the Chalk, which they resemble in scales, fins, and general appearance.

4. The genus *Platax*, of the family Carangidæ, also remarkable for a resemblance in fins and contour to the *Beryx* above named.

Briefly, these four types, now so distinct, were related at the epoch of their origin by certain common characters actually diminished or effaced since then; so that we might represent the history of the Ctenoids by means of a bundle of diverging lines, between which should be inscribed all those families which did not exist before the Cretaceous period.

Some other families of Teleosteans have a few rare representatives at Mount Lebanon. We shall not linger over these, and shall content ourselves with indicating one or two Sparoids, one or two Gobioids, and a curious genus (*Petalopteryx*) belonging probably to the Cataphracti.

In order to render complete this notice of the faunas of Lebanon, it would only remain for us to say a few words relative to an order which we have already named above—that of the Hoplopleuridæ, the relations of which have been contested: this, however, would lead us too far. We would refer to our memoir for the detailed treatment of this question; it will there be seen that all arguments in favour of their affinity with the Ganoids are highly contestable, and that these fishes are true Teleosteans.

The Hoplopleuridæ characterized by longitudinal series of shields form a group at present proper to the Cretaceous period. They themselves contribute largely to stamp the physiognomy of the Lebanon faunas.

These various facts may further be summed up as follows:—

The Lebanon faunas have, like the other Cretaceous faunas, in the more essential points, their relations entirely with the subsequent, and never with preceding faunas. The commencement of the Cretaceous period has been, as concerns this class, a period of great modification and renovation of forms. The principal general character consists in the sudden disappearance of Ganoids, these being replaced by an abundance of Teleosteans.

If we compare them with subsequent faunas (tertiary and modern) we find that they are composed of the same families, only in different proportions.

The most important is that of the Halecoids (*Salmones* and *Clupeæ*), which may be regarded as the continuation of certain Jurassic genera. This is the only family of Teleosteans with so remote an origin. It is also the one which reproduces in the

most marked degree the normal and typical forms of the Fish. The salmon and herrings of our waters are, of all fishes, those which have best preserved the original forms; they are also those which have the longest known pedigrees.

The great Ctenoid division, so varied and important at the present day, has no known root before the Cretaceous epoch. It is represented by a certain number of types bound together by numerous common characters, especially of general appearance and external covering. These types form the base of a large bundle or knot, the various threads of which have become, through successive ages, gradually more and more differentiated and widely removed from each other and the common stock.

The third group which has played an important part in the history of these Teleosteans is that of the Hoplopleuridæ, more isolated than the preceding ones. There is no indication of this group in the Jurassic period, nor any continuation of it in the Tertiary.

These three groups form almost the totality of the Teleosteans. There would now only remain to add, in the present state of our knowledge, some few isolated genera with whose history we are but incompletely acquainted, and which would seem to be subordinate to the preceding ones as much on the ground of this isolation as on that of the small number of individuals representing them.

BIBLIOGRAPHICAL NOTICES.

A History of British Sessile-eyed Crustacea. By C. Spence Bate and J. O. Westwood. Part XIII. 8vo. Van Voorst. London, 1866.

The appearance of a new part of this valuable work, after an interruption of nearly three years (the twelfth part was published in August 1863), leads us to say a few words about it, in the hope that, however we may regret such delays, the interval in the present case may have given time for the training of a new school of students, to whom such a book as this will be welcome.

In the first volume, completed in 1863, the authors nearly finished their descriptions of the British species of true Amphipoda, leaving only the Hyperine forms for the commencement of the second volume. The *Amphipoda aberrantia* of Mr. Spence Bate, including the *Læmodipoda* of Latreille, with the addition of the *Dulichiidæ* of Dana, are completed in the part just published, which also contains the general remarks on the Isopodous order.

In form, the Crustaceans here described are among the most singular of the inhabitants of the sea, although their relationship to the true Amphipoda is so evident that one feels surprised they could

ever have been separated therefrom as a distinct order. It seems to us, however, that the authors have to a certain extent been in error in placing the *Dulichiidæ* among the aberrant Amphipoda, their true alliance being evidently to the typical section, with which they are described as agreeing in every respect, except in having the last two segments of the "pereion" fused into one, and the last segment of the "pleon" absent. In all other characters, such as especially the full development of the tail, the absence of rudimentary feet, and the separation of the coxæ from the segments on which they stand, the *Dulichiidæ* agree with the higher Amphipoda, and differ in the same proportion from the aberrant forms, whether we take the spectral *Caprellæ* or the louse-like *Cyami* as typical of the second group. This, however, is an objection easily got over; and we can only express a hope that the renewed publication of the book may now proceed regularly, and that it will find as many purchasers as its careful elaboration and the beauty of its printing and illustration certainly entitle its publisher to expect.

A Catalogue of Phytophaga (*Coleoptera, Pseudotetramera*). By the Rev. HAMLET CLARK. Part I. *With an Appendix, containing Descriptions of new Species,* by H. W. BATES and the Rev. HAMLET CLARK. 8vo. London: Williams and Norgate, 1866.

During the eighteen years that have elapsed since the completion of Lacordaire's classical Monograph of the Phytophaga, entomologists have been most industrious in describing new genera and species of this most attractive group of beetles. The result of this industry is the accumulation of a vast mass of more or less scattered descriptions of newly discovered forms, which renders it exceedingly difficult for an entomologist not making a special study of the group to arrive at anything like a clear notion of the number of species and genera already known. The Rev. Hamlet Clark (the author of the Catalogue now before us) and Mr. J. S. Baly may be noted as among the most active cultivators of this particular department of entomology, the latter especially exhibiting a power of production which has already rendered his publications very voluminous. It is a question, indeed, how far he may be regarded as doing good service to science by the publication of such an infinity of detached notices; but it is quite clear that, until he begins to devote his energies to some other group of insects, that monographic revision of the Phytophaga which has already become almost an absolute necessity, and which will undoubtedly bring about the suppression of a host of modern so-called genera, had better be postponed.

In the meanwhile entomologists will be thankful to the Rev. Hamlet Clark for the catalogue with which he proposes to furnish them, and of which the first part, including the four Crioceride groups, Sagridæ, Donacidæ, Crioceridæ, and Megalopidæ, is now before us. In this catalogue we find the generic and specific synonymy of the insects belonging to these groups concisely but clearly set forth, with full

bibliographic references and statements of habitat, and under each genus references to the published descriptions, if any are in existence, of the transformations of the species.

From the careful manner in which it has been prepared, this work cannot but be of the greatest service to future students of the Phytophaga, more especially if the author be enabled, as we trust he may, to finish the remaining (and far more difficult) portion of his task in the same style.

The Appendix consists of descriptions of new species (cited in their proper places in the catalogue) by the author and Mr. H. W. Bates, the latter describing those Amazonian species which were collected by himself. These descriptions are very numerous.

PROCEEDINGS OF LEARNED SOCIETIES.

ROYAL SOCIETY.

June 21, 1866.—Lieut.-General Sabine, President, in the Chair.

"Observations on the Ovum of Osseous Fishes." By W. H. Ransom, M.D.

In this paper the author has communicated the details of observations of which the principal results were stated in a short paper published in the Proceedings of the Royal Society in 1854, and of further researches on the structure and properties of the egg in several species of osseous fishes. The methods employed in determining the functions of the micropyle, and in conducting the various inquiries entered upon, are described. The development of the ovarian ovum is traced in two species of *Gasterosteus*; and the yelk-sac is shown to increase by interstitial growth, and not by apposition of layers on either surface. A minute description of the germinal vesicle and its contents is given; and the germinal spots are shown to be drops of a thick fluid substance so apt to change their normally round form and to vacuolate in their interior, that no perfectly indifferent medium was found in which to examine them. The primitive yelk first formed around the germinal vesicle is shown to differ in some of its chemical and physical properties from that of the ripe ovum; it is solid, and does not consist of two distinguishable portions. On its surface a yelk-sac was found in very early ova, but in the smallest eggs examined it could not be separated.

The reactions of a variety of albumen allied to myosin, which the author has found in variable proportions in the yelk of all the fishes, amphibia, and birds which he has examined, are described, the yelk of the salmon being selected for experiment. This substance, to which the name albumen C is given provisionally, is remarkable, in addition to its being easily precipitable by water in excess, for forming under certain conditions a solution in dilute nitric acid not coagulable by boiling.

Some account is rendered of the reactions of an acid compound of

phosphoric acid with an organic substance also met with in the yelk of various animals.

The phenomena which follow impregnation prior to the commencement of cleavage are described, and are shown to be chiefly due to the influence upon the yelk of water which has passed through the yelk-sac.

Some variations which occur in this respect in different species of osseous fishes are described; and the ova of *Gasterosteus* are shown to be remarkable in having a viscid mucoid covering derived from the oviduct, which prevents the imbibition of water through the yelk-sac, so that it only enters and forms a breathing-chamber after impregnation, when it passes through the aperture in the apex of the micropyle; whereas in the eggs of salmon and in those of most other fishes, unimpregnated ova rapidly absorb water by the whole surface of the yelk-sac, the yelk contracting at the same time to form the breathing-chamber.

The concentration of the formative yelk, originally forming a thin layer over the whole yelk-ball, at the germinal pole is also proved to be due to the action of water, of which it requires a free supply sufficient to distend the yelk-sac, and to be independent of fecundation.

The contractions of the yelk are shown to be also independent of the action of the spermatozoids, and to be reactions following the entrance of water into the breathing-chamber—and this not only as regards the rhythmic waves which pass over the surface of the food-yelk, but also the fissile contractility of the formative yelk, by virtue of which it cleaves into irregular and unsymmetrical masses, and which the author conceives to be only regulated by the influence of the seminal particles.

The cortical layer of the food-yelk or inner sac, which is shown to resist in a remarkable manner osmosis, is found to be the rhythmically contractile part, although requiring for its manifestation the presence of acid food-yelk upon its inner surface.

Evidence is given to show that the contractile property of the yelk of both kinds requires, as an essential condition of its manifestation, the presence of oxygen in the surrounding medium, and that the food-yelk, while the rhythmic waves are passing over it, consumes less than does the formative yelk, while regularly cleaving after fecundation,—also that some product of oxidation is formed during these movements, which itself tends to check them, but which the author failed to determine the nature of.

Proofs are also given that a certain moderate rise of temperature increases the activity of these contractions. Experiments are related which show the extreme limits the yelk will bear without destroying them, and the temperature at which commencing chemical change prevents further contraction.

The reactions of the substance of the yelk under the stimulus of galvanism are recorded, and evidence afforded that the food-yelk and the cortical layer alone are excited to contraction by it, attempts made to induce fissile or other contractions of the formative yelk resulting in electrolysis of that highly unstable substance.

Experiments made to ascertain the effects produced by poisonous substances on the contractions of the yelk are recorded, and the general fact ascertained of the extreme indifference to such agents of yelk-protoplasm.

Carbonic acid, however, is shown to destroy the contractility rapidly, and chloroform to arrest it for a time.

The process of cleavage is described, and experiments are given which show that oxygen in the surrounding medium is an essential condition of its occurrence. The influence of heat in quickening it, and the comparative indifference which it shows to the action of a galvanic current and to most poisons, are proved by a series of experiments, in which also the remarkable and destructive activity of carbonic acid is evidenced.

The author has considered the egg as a cell, its contents as a protoplasm, of which the firmer cortical layer is the equivalent of the primordial utricle, and the fluid food-yelk of the liquid contents, while the formative yelk is represented by the granular accumulation around the nucleus. Two stages or grades of development of protoplasm are conceived to be represented by the two forms of yelk; and a parallelism is attempted to be drawn between them and the stages of development through which many amœboid organisms pass, and which the author believes to have a wide if not a universal existence in the organic world,—the lower grade, represented by the homogeneous food-yelk with a cortical layer and possessed of rhythmic contractility, passing into the higher, represented by the formative yelk, of a granular structure and possessed of a fissile contractile property only.

"On the Congelation of Animals." By John Davy, M.D., F.R.S. &c. Received since the end of the Session.

In a very interesting and elaborate paper by M. Puget, entitled "Sur la Congélation des Animaux," published in the Number of the 'Journal de l'Anatomie et de la Physiologie' for January and February of this year, he refers to a statement of mine, made many years ago*, that the leech may be frozen without loss of life. The experiments which he has instituted, and which appear to have been conducted with great care, have led him to an opposite conclusion—viz. that congelation is not only fatal to the leech, but to animals generally, without a single exception. He considers the cause of death (the *vera causa*, to use his own words) to be an altered condition of the blood. In consequence of this statement, I thought it right to repeat the experiments on the leech, and to extend them to some other animals. They were begun at Oxford in May, in the laboratory of Professor Rolleston, with the kind assistance of Mr. Edward Chapman and Mr. Robertson; and since then, in the following month, they have been continued at home in Westmoreland.

At Oxford the trials were made on leeches and frogs; at home, on these animals, and on the toad and some insects. The freezing-

* Researches Physiol. and Anat. ii. p. 121.

mixture was made of pounded ice and common salt; the temperature by it was commonly reduced to below 10° Fahr., or at times so low as 2° or 3°. The results obtained were briefly the following:—

1. A leech was exposed to the mixture in a small glass tube just large enough to hold it, using the tube for stirring the mixture. Taken out when perfectly rigid and hard, and gradually thawed, it showed when punctured a faint indication of irritability; there was a just perceptible contraction of the part punctured, the oral extremity, and nowhere else. It did not revive.

2. Another leech was similarly exposed, but for a shorter time. When divided by an incision, it was found not frozen throughout. When punctured, it showed marks of irritability in a slight degree stronger than the preceding: it soon died.

3. Two leeches were similarly treated at home, and for a somewhat longer time, the temperature reduced to 3°. These, when gradually thawed, one exposed to the air, the other left in the mixture, showed no marks of revival; but they retained a certain elasticity, so that when bent they shortly recovered their former attitude, after a manner somewhat resembling a vital movement; but inasmuch as they did not respond by the slightest contraction to puncture, it may be inferred that the movement was not vital. They resisted putrefaction for many days.

4. A frog in a thin glass vessel was kept in the mixture about a quarter of an hour. It was very rigid when taken out; thawed, no part, on puncture, afforded any indications of life; watched two or three hours, it proved to be dead.

5. The heart of a frog, removed immediately after decapitation, whilst still pulsating, was subjected to the freezing-mixture in a small glass tube. After having been frozen, on thawing it remained motionless, even when punctured. It had been kept in the mixture only a few minutes.

6. The inferior extremities of a frog kept extended by a bandage and thus introduced into a glass tube, were submerged in the mixture, the body of the frog being held in the warm hand; taken out after some minutes they were quite hard and motionless, whilst the body and upper extremities did not appear to be affected. It moved about, dragging the lower extremities as if they were dead. In about four hours it recovered the use of its femoral muscles, on the following day the use of the muscles of the legs; the day after, it was able to bend and extend these limbs; but there was no proof that its feet had recovered sensibility. On the fourth day it was found dead.

7. The lower extremities of a large toad were immersed in direct contact with the mixture, the temperature falling to 3°. Gradually thawed, the parts showed no marks of life. This toad, which before the trial was in a dull state, afterward became almost torpid, and so continued until the following morning, when it was apparently dead: opened, the auricles were found feebly acting, ceasing after a few seconds*.

* This toad was a female which had shed her ova; the oviduct was still large; the stomach was distended with caterpillars, slugs, &c., seeming to show that

8. A similar experiment was made on the lower extremities of an active frog, and with a similar result, except that the vivacity of the animal was for a short time but little impaired: after four hours it was apparently dead; opened, its auricles contracted when punctured. It may be right to mention that, before exposing the toad and frog to the freezing-mixture in direct contact, it was ascertained that the frog bore the immersion of its lower extremities in a saturated solution of common salt without any apparent loss of sensibility or motive power*.

9. The lower extremities of an active frog of a large size were wrapped in tin-foil, and, together with one of its upper extremities not so wrapped, were kept in a freezing-mixture about a quarter of an hour. The frozen parts in thawing showed no marks of life. The frog died in about three hours.

10. A cockroach, a flesh-fly, and a minute insect, an ichneumon† (*Cœlineus niger*?), confined together in a small glass tube, were kept some minutes in the mixture. Thawed, they were found all three dead.

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there was no diseased state. It is noteworthy that the apertures of the cutaneous glands appeared to be closed; for when the animal was irritated, there was no ejection of the acrid fluid, a circumstance I had before noticed in a female during the breeding-season, suggestive of a condition of surface favourable to the male in the generative act. When the tubercles were incised, they were found to contain the acrid fluid in plenty, and, judging from its bitter taste and the irritating effects of an extremely small portion applied to the tongue, not deficient in activity. The same state of the cuticular glands was found in another female toad killed by congelation, which had shed few of its ova,—this on the 23rd of June. It was of a lighter colour than usual. It was found likewise in two examined in July, in which some ova remained.

* The effect of immersion of the lower extremities of a frog in a saturated solution of common salt varies, I find, according to the length of time; if for a very few minutes, it is inconsiderable; if for many, it is well marked; and if much prolonged, it is fatal. In one instance, after a quarter of an hour's immersion, the limbs seemed paralyzed, the animal in a state approaching to torpor: after having been well washed in fresh water it slowly recovered its activity, and the limbs their motive power and sensibility,—their motive power first, their sensibility later—indeed not until the following morning, judging from the effects of puncture. After a longer immersion, with a fatal result, the limbs had become rigid and somewhat hard, especially the feet, as if their juices had been extracted by osmotic action. Opened after three hours, even the auricles were motionless, and this when punctured. The muscles of the limbs no longer showed a striated structure, whilst those of the upper extremities displayed this structure distinctly.

The toad, with a thicker skin, was found to bear the immersion of its extremities for a longer time; but the difference seemed to be only in degree; much longer continued, the same effects were produced, viz. rigidity, with loss of motion and sensibility, which (the immersion not being too long) were slowly recovered after freshwater ablution.

The blood-corpuscles, acted on by the same solution, underwent a change, contracting slightly, and acquiring a granular appearance, commencing in their nuclei.

† For the name of this insect I am indebted to Dr. Gray, F.R.S. It was selected on account of its minuteness: it weighed hardly $\frac{1}{100}$ of a grain; it seemed probable, on account of the minuteness of its vessels, that its fluids might escape congelation, after the manner of fluids in capillary tubes, which may be reduced many degrees in temperature without being frozen.

These results, so far as the particular instances are concerned, are sufficiently confirmatory of M. Puget's; and on my mind they leave little doubt that his general proposition (his inference from his very numerous experiments) is correct, that congelation is fatal to animal life. It is hardly worth while to attempt to account for the different conclusion I had come to (that referred to by him relative to the leech), it being partly founded on the fact that leeches which had been enveloped in ice for many days were not thereby killed, and partly on witnessing some marks of vitality in leeches which were believed to have been artificially frozen, and which very soon after died.

Whilst admitting that congelation, thorough congelation, of an animal is incompatible with life, the cause of death from congelation seems open to question, and more especially that assigned by M. Puget as the *vera causa*—a change in the blood, and chiefly in its corpuscles. That these corpuscles are changed by freezing in form and condition seems to be certain. Before seeing M. Puget's paper I had ascertained the fact, and not only that the corpuscles were changed, but also that the entire blood was to some extent altered, leading me at the time to ask whether some of the injurious effects of frost-bite may not be mainly owing to the freezing of the blood and the changes in consequence in the corpuscles and, in a less degree, in the fibrin *; and since, in examining the blood of the animals exposed to the freezing-mixture, I have had this confirmed; but the change in these instances was comparatively slight; even in those of the congealed limbs of the frogs and toad the majority of the corpuscles appeared little altered; some few seemed ruptured, some corrugated, and more contracted.

Judging from the effect of congelation on the heart of the frog in experiment No. 5, and from the effects of congelation partially produced, as in the extremities of the frog and toad, I would rather attribute the death to the freezing of the organs, not excluding the blood, than to the freezing of the blood alone; and I would ask, is not this view most in accordance with the pathology of the subject, with all that we know of frost-bite and its consequences in man, and with the results of Mr. Hunter's experiments on the local effects of congelation in animals—those on the ear of the rabbit and wattle of the cock †? and do not some even of M. Puget's results give it support, such as the opacity of the crystalline lens, he admitting that, were it possible for an animal to revive after complete congelation, it would be blind from cataract? Now, if the crystalline lens, if the blood-corpuscles suffer and undergo an appreciable change from congelation, it would be very remarkable indeed did not the brain and nerves, and the organs generally, suffer from the same cause, and experience changes incompatible with life. In the instance of man, we know that a certain reduction of his temperature

* Physiological Researches, 1863, p. 371. See also Trans. Royal Society of Edinburgh, 1865, vol. xxiv. p. 26.

† Phil. Trans. 1778, p. 34.

merely, not reaching to congelation, suffices to extinguish life *, and that in the instances of other animals, especially the hybernating and insects, a moderate reduction occasions torpor, ending in death if too prolonged. That the organs generally suffer from congelation M. Puget himself admits, as expressed in the subjoined paragraph †. I have found, too, that the muscles, after having been frozen, exhibit a marked change: thus, in one instance, that of a frog, in which, after decapitation, an upper and lower extremity were frozen, the muscles of these limbs, when thawed, compared with those which had not been frozen, showed a well-marked difference under the microscope; for whilst in the latter the striated structure was very distinct, in the former it was no longer visible; and after a few hours, viz. on the following morning, whilst the unfrozen muscles had undergone no perceptible alteration, those which had been frozen had become of increased tenderness, yielding to a slight rending force, and breaking short, as if the coherence of the particles forming the fasciculi had become greatly diminished.

MISCELLANEOUS.

On a Cranium of Ziphius *found at Arcachon (Gironde).* By P. Fischer.

A magnificent cranium of a Cetacean, found in 1864 at Lanton, on the shores of the harbour of Arcachon, has been sent to M. Filloux. The most superficial examination of this is sufficient to show that it belongs to an individual of the genus *Ziphius* of Cuvier.

If doubts have prevailed as to the origin of the *Ziphius* represented as fossil by the great anatomist (Ossem. Foss. tome v. 1re partie, pl. 27. fig. 3) from an imperfect specimen dug up at the mouth of the Galégeon (Bouches-du-Rhône), there can be none as to the cranium from Arcachon. Its perfect state of preservation, and the presence of fatty matters in its cerebral cavity, prove that the death of this Cetacean cannot even be very remote.

The length of the cranium, from the occipital foramen to the anterior extremity of the intermaxillary bones, is 89 centimetres; its breadth, from the orbital margin of the right frontal to that of the opposite side, is 48 centimetres; its height, from the base of the cranium to the upper margin of the nasal bones, is 41 centimetres.

The upper surface of the head is remarkable for the enormous development of the intermaxillaries, and their want of symmetry. In front they surround a very thick and prominent ivory-like tuberosity of the vomer; posteriorly they spread out, rise up and cir-

* Instances have occurred in the Lake District of persons who have perished on the hills from prolonged exposure to strong wind and rain, *storm-stricken*, in the language of the country.

† "... La congélation complète a même si profondément altéré les tissus de l'organisme que quand l'animal est tout-à-fait dégelé, son corps est flasque et mou, ses cristallins sont blancs et opaques, et souvent sa coloration est tout-à-fait altérée" (p. 24).

cumscribe the anterior orifice of the nostrils, which is dominated by the nasal bones, also unsymmetrical, soldered together on the median line, and resembling in their totality a leaf of trefoil, in consequence of the two notches which deeply divide them. The right intermaxillary is considerably broader than the left one; in consequence the nostrils are thrown down to the left.

Between the crests of the intermaxillaries and the margins of the maxillaries which are concentric with them, there exists a broad fossa, which may be denominated suborbital. The skull, seen from above, therefore presents three enormous excavations—namely, a median or nasal one, limited externally by the intermaxillaries, and two lateral or suborbital ones, limited externally by the maxillaries.

On the lower surface of the cranium we find the intermaxillaries in front forming the beak of the upper jaw, and much more developed than in other Cetacea. The vomer appears only as a very thin lamina, placed on the median line, at a little distance from the intermaxillaries.

The posterior orifice of the nasal fossæ is situated on the median line, and bounded in front and laterally by broad pterygoids.

The lateral surfaces of the cranium present a reduced orbital cavity at the margin of the frontal; posteriorly the zygomatic apophysis of the temporal does not become united to the postorbital apophysis of the frontal; in front there exists a fragment of the jugal, united to the upper maxillary. The jugal apophysis is wanting, and with it the inferior boundary of the orbit.

The maxillary passing above the orbital apophysis of the frontal, causes a change in the position of the suborbital foramen, which becomes supraorbital in *Ziphius*, as in the Cachalot.

The temporal fossæ are deep, but not broad.

The posterior surface of the cranium is almost entirely composed of the occipital bones; it is subtriangular, terminated above by a narrowed portion of the frontal articulated with the nasals. The occipital foramen is situated at the lower third of its height. The cerebral cavity is spacious and of considerable transverse diameter; the falx is very high.

I cannot at present give more than these imperfect details, which are the result of a first examination; but I am struck with the affinity of *Ziphius* to the Cachalots and Hyperoodons. It is, however, distinguished from them by the extreme elevation of the posterior ascending portion of the intermaxillaries; in the Hyperoodons, on the contrary, the parts most developed are the maxillary crests. Lastly, I shall call the attention of anatomists to the singular ivory-like tuberosity of the vomer, the purpose of which seems very enigmatical to me.

I suppose the cranium of Arcachon to be identical with that of the Galégeon, although I cannot assert this to be the case, but hope to arrive at a more positive conclusion after a comparative examination of the two specimens.

By this discovery we at least acquire a knowledge of an interesting fact, namely the existence of living specimens of *Ziphius* in the

Atlantic; for hitherto their remains have been found only on the shores of the Mediterranean. In the fossil state, *Ziphii* (*Choneziphius*, Duv.) abound in the Antwerp Crag.—*Comptes Rendus*, Aug. 6, 1866, pp. 271–272.

Notes on the Domestic Animals and Plants of the Thirteenth and Fourteenth Centuries. By JAMES E. THOROLD ROGERS, M.A., &c. &c.

In Prof. Rogers's recently published 'History of Agriculture and Prices in England, compiled entirely from original and contemporary Records, from 1259 to 1400,' there are some interesting facts connected with domestic animals, which, being derived from contemporary records, are of undoubted authority:—

"Partridges were plentiful enough, and were, it appears, generally captured by hawks, and occasionally in nets. Hares may have existed, probably did; but I have never seen an entry of them. Pheasants were, it seems, unknown. Rabbits were found in some localities, but they were very dear" (vol. i. p. 65).

"I do not doubt that these [hare and pheasant] existed, as they are mentioned in chronicles and recited in deeds" (p. 33).

"The banquet [the determination feast of Richard, the son of Thomas Holland, Earl of Kent, on Shrove Tuesday, 1398] appears to have lasted two days. The quantity of beef and mutton consumed was not large; no wonder, for the feast was held in winter; but pork, lamb, and veal were abundantly supplied. Kid is also found; a rare article of food with our ancestors. The poultry consumed in the feast is the largest and most characteristic item. Fowls, capons, geese, ducks, swans, and peacocks are purchased. Amongst wild fowl we find partridges, teals, wild ducks, *Gastrimargii* (which I cannot identify), snipes, plovers, ousels (that is, blackbirds), thrushes, and fieldfares, and, lastly, *Upupæ*, which should mean hoopoes, though I can hardly imagine that these birds could have been found in this country in winter time. The swans and geese were fattened in coops on oats and peas. Rabbits, bought as usual at high prices, are also found, forty couple of which are brought from Bushey, in Herts" (pp. 122–123).

Chapter xvi., "The Price of Live Stock," p. 326, contains some most interesting particulars. We extract the following:—"The same kind of stock which is now kept on an English farm was kept five or six hundred years ago. Oxen, cows, horses, pigs, sheep, and poultry were almost invariably reared, though, of course, just as now, lands which were either not available for sheep-farming, or were more profitably occupied in the manufacture of dairy produce, maintained no sheep" (p. 326). "Pigs, too, were the most important kind of animal food. The necessity of using salted meat during a moiety of the year led our forefathers to breed pigs largely, since no meat, it appears, takes salt more readily or preserves its nutritive properties after curing so fully as pork. And besides, poultry, to judge from the price and from the frequent recurrence of poultry-rents in the

rental of estates, must have been very common. A market also was found for capons and geese. Ducks were comparatively rare; and pigeon-houses, kept on most manorial estates, were, no doubt, a nuisance and a wrong, similar if not equal to the dove-cots of France during the monarchy" (p. 327).

"It will be found, on investigating the table given in the second volume, that the price of cows was considerably less than that of oxen. Bulls, too, were cheap, though the entries are not numerous. These facts seem to prove that no attempt was made to improve the breed" (p. 327). "There seems to be no great variety of breeds; at least there is no notable difference of price between north and south country cattle. In all likelihood the breed was the small ox now found in Scotland and other mountainous regions. I have already adverted to the fact that unless cattle had deteriorated in the sixteenth century—a circumstance by no means probable—the carcase was light; for the oxen bought for victualling the navy were not more than 4 cwt. in weight on the average. Taking the hide, a very valuable part of the animal in the middle ages, at an average of 2*s.* 6*d.* (it was sometimes much dearer), the flesh of the average ox would be worth 10*s.* 6*d.*" (p. 329).

"The horses used in mediæval husbandry are distinguished as *affri*; called also stotts and cart-horses. The former may perhaps be still discovered in the coarsely shaped small horses still found in country districts, and employed in the commonest drudgery, whose value chiefly lies in the fact that they are able to subsist on very poor and scanty fare, and can do a great deal of work at a very small cost. These animals are a little, but not much, dearer than oxen, their price being lowest in dear years—probably because when oxen were costlier their use in draught increased, and the value of the small horse declined. Occasionally, however, they sold at considerable prices. Cart-horses are much more valuable than *affri*, and are sometimes, speaking relatively, very dear. Saddle-horses were occasionally very costly, but often sold at no higher prices than those obtained for others employed in agricultural work only" (p. 330).

"Sheep are distinguished as muttons, *i. e.* wethers, as ewes, hoggasts, hoggasters, hoggerels, or bidentes; hurtards or rams, and lambs. Of these, lambs are, of course, the cheapest, though sometimes their price is so high that I have treated them as hoggasters. Occasionally young ewes are quoted under the name of *jercion*. Ewes are very low-priced. Hurtards or rams are not mentioned very often, and are generally dear" (p. 332). "Sheep were liable to several diseases, and among them the rot and the scab" (p. 334).

"Towards the close of the thirteenth century sheep were for the first time affected by a new disease, which has been handed down to our own time under the name of scab. In the few last years of the same century tar dressing was adopted, and has been, I believe, uninterruptedly employed from that to the present time.

"While the sheep was valuable to the richer persons in mediæval society, the most important animal in mediæval economy was the pig. It is not easy, however, since no weights are given, to arrive with

any accuracy at the money value of the animal" (p. 335). "Pigs are occasionally said to be leprous, and are especially liable to measles —that is, to entozoa; and the accounts frequently allude to forced sales of animals in which the latter disease was present and suspected, though it does not appear that such a circumstance seriously depreciated the market value of the animal" (p. 337). "Wild boars, though rarely mentioned, are not unknown" (p. 337).

"There is abundant evidence as to the price of poultry. Of these, the commonest are geese, capons, hens, and pigeons. All are reckoned by the head except the last, which are invariably quoted in the accounts at so many a penny" (p. 338). "Besides the poultry, our forefathers kept swans and peacocks; the average price of the former is 3*s*. 9½*d*. Peacocks are bought at 2*s*. in 1278, and at 5*s*. in 1395" (p. 340).

"The animals [rabbits] are so dear as to suggest either that they were at this time confined to particular localities, from which they have subsequently spread over the whole country (a view which seems to be countenanced by the fact that the price does not increase in the later part of the period), or that they were, which we can hardly believe, rigorously and effectually protected in the interest of the great landowners. They were sold at 5*d*. each in 1270, and from 3*d*. to 4½*d*. afterwards" (p. 340).

"We know but little of the period at which animals now familiar were introduced into England. Thus, though I am far from saying that they could not have been found, it is a little singular that I have never met with any entry of hares or pheasants in the period before me; and it is the more remarkable in the earlier period, because the Bigod and Clare accounts give considerable detail of the domestic life and expenditure of the Earl of Norfolk and Gloucester" (p. 341).

"Fish, as the reader will discover, was by no means a cheap article of food in the middle ages. It was so dear that in the time before us it could hardly have been consumed by the poorer classes except as a luxury or a relish. Nor does this observation apply only to the better kind of fresh fish, as lamprey, salmon, pike, and eels. Herrings and ordinary salt fish and stock fish were, on the whole, relatively dear. The stories told of the exceeding plenty and cheapness of salmon, if they are not purely local, even in later times, would not, as far as can be inferred from the account before me, have been true of the thirteenth and fourteenth centuries" (p. 606).

"Most kinds of fish were sold salted as well as fresh; the business of a stock-fishmonger being a regular branch of trade in mediæval times. Thus we not only read of salt herrings red and white, but of salmon, eels, sturgeon, lamprey, and haddock, lyng, *moruca* (which are said to be cod), mulvells, melyns, hake, *hoburden*, cropling, dog-drave, and hard, stock and salt fish, all of which are cured in this manner" (p. 607).

"There may have been many other kinds of fish kept which do not come generally into the market, or were not purchased by such persons as supply us with information. Hence it is possible that

trout, perch, carp, and barbel may have been well known in the fourteenth century; but I have seen none of these fish in my accounts" (p. 608).

"The few entries of oysters (some in the earlier part of the inquiry, some in the last few years), five of them are taken from the roll of Thorney in Sussex, the rate being uniformly a halfpenny the hundred. Mussels and oysters are from Sharpness in Kent, each at 7*d.* per bushel" (p. 617).

"The manor house possessed a garden and orchard. But the former was very deficient in vegetables. The householder of the thirteenth and fourteenth centuries grew onions and leeks, mustard, and garden or green peas. He probably also possessed cabbages, though I have never found either seed or plant quoted. Apples and sometimes pears are mentioned as part of the orchard produce; but we read of no plums, except once of damsons. A regular part of the produce of the orchard was cider, and its low price seems to suggest that it was made in considerable quantities. Sometimes, too, wine was grown in England, though not, perhaps, so frequently as has been imagined, the word *vivarium* having been, it appears, often read *vinarium*. Crabs were collected in order to manufacture verjuice—an important item in mediæval cookery. Bees, though honey was dear and wax very high-priced, do not seem to have been commonly kept, though some few entries of hives and swarms have been found" (p. 18).

"The people lived on salt meat half the year; and not only were they without potatoes, but they do not appear to have had other roots which are now in common use, as carrots and parsnips; onions and cabbages appear to have been the only esculent vegetables. It will be found that nettles (if we can identify these with *Urticæ*) were sold from the garden. Spices (the cheapest of which was pepper) were quite out of their reach; sugar was a very costly luxury; and our forefathers do not appear, judging from the rarity of the notices, to have been skilful in the management of bees" (p. 66).

"The hay was gathered into ricks, and, as at present, cut into trusses. It is hardly needful to observe that the grass was all native; it was long after the period before us that artificial or foreign grasses were introduced. Hence the means of supporting winter stock depended upon the supply of hay and such straw as was available for the animals kept on the farm. The bailiff calculated his resources, and killed down for salting at about St. Martin's Day (November 11) as many sheep, oxen, and calves as exceeded his means of sustenance" (p. 16).

"It will be seen that the largest part of the land under the plough was occupied by crops of wheat, barley, and oats. Wheat was the customary food of the people of this country from the earliest times. Even if the evidence were not abundant on this point, the breadth sown annually would be conclusive proof. Barley was sometimes mixed with wheat in the allowances made to farm-servants; but its chief use was in the manufacture of beer, which seems to have been

continually brewed in small quantities and for immediate consumption. Wheat is sometimes, but rarely, malted; oat malt is much more common. The chief use of the oat was for horse-food; but oatmeal was made for the broth or porridge of the house. Rye was very scantily cultivated. A peculiar kind of barley called drageum is very generally cultivated, especially in the eastern counties; drage, like barley, was made into malt. The three leguminous plants, beans, peas, and vetches, were generally not extensively cultivated, the average being small in every case" (p. 27). "Hemp was cultivated to some extent; it was employed for the home manufacture of ropes" (p. 28).

On Postfloration. By D. Clos.

It was only at the commencement of the present century that attention was first paid to æstivation and its importance in classification was recognized. But if the relative position of the floral parts of the same whorl before the expansion of the flower deserves to be taken into consideration, would it not appear *à priori* that their different appearances after anthesis should also possess some interest?

In 1859 M. Fermond indicated the part played in the act of fecundation by the perianth of certain plants. But is there in certain families, genera, or subgenera something of a general character in the arrangement of the floral organs, and especially of the petals, after the accomplishment of fecundation? I have in vain consulted the Annals of Science on this question, and now communicate to the Academy my first observations on the subject.

There are some plants which lose their calyx or their corolla soon after their expansion, and which, for this reason alone, have no postfloration. Thus the sepals of the Papaveraceæ and of many Cruciferæ, the petals of the Papaveraceæ and Cistineæ, and of *Rhexia virginica*, and the corollas of *Alonzoa*, of the Chinese Primrose, &c. fall very soon.

Others have no distinct postfloration, their petals retaining, after anthesis, the same arrangement which they possessed before expansion. Such are the Saxifrages, *Lycium*, *Cestrum aurantiacum*, and *Cajophora lateritia*. In *Pelargonium* these organs become slightly curled.

It is rarely that the postfloration reproduces the æstivation. Nevertheless the families Malvaceæ and Oxalideæ present us with petals resuming, during their withering, the same twisted arrangement that they had in the bud.

The following are the principal types of postfloration that I have been able to distinguish:—

1. Closed (*postfloratio occlusa*).—The petals of *Echeveria*, after flowering, approach each other and close the orifice of the corolla.

2. Patulous (*postfl. patula*).—The perianth of *Boussingaultia*

basselloides, and of the Clematites, which is wide open in flowering, becomes still more widely spread after fecundation.

3. Reflexed (*postfl. reflexa*), presented by the *Begoniæ*, especially *B. semperflorens*, and by *Crassulæ spathulata* and *cotyledon*.

4. Shrivelled (*postfl. crispa*).—The petals retain their position and form, but become shrivelled in drying. Ex.: *Pavia, Delphinium, Lythrum*, and the corolla of the *Campanulæ, Linariæ*, &c. Sometimes the perianths in shrivelling become twisted irregularly: this modification of the shrivelled postfloration is presented by *Clerodendron*.

5. Pulpy (*postfl. pulposa*).—In *Tradescantia virginica* the petals lose their membranous aspect and become pulpy.

6. Curled or Circinate (*postfl. circinata*).—The petals of the Capparideæ (*Capparis, Cleome, Gynandropsis*), which are twisted in æstivation, become rolled into a crook after anthesis. This is also the case with the corolla of the Peruvian Heliotrope and of *Verbena Melindres, chamædrifolia*, and *tenera*.

7. Recircinate (*postfl. recircinata*).—In *Mesembryanthemum* and *Cryptostemma calendulaceum* the petals and ligulæ become rolled into a crook, but from within outwards, or in an opposite direction to the circinate form.

8. Conduplicate (*postfl. conduplicata*), one of the lateral halves of the inner surface of the petal applying itself to the other. Ex. *Ornithogalum Eckloni*.

Postfloration may render some service to classification, especially in the limitation of genera. Authors are not agreed as to the generic denomination of the *Agrostemma Cœli-rosa* of Linné. Desrousseaux has placed it in *Lychnis*; it is a *Silene* with MM. Grenier and Godron, and a *Viscaria* with others. It is distinguished from *Silene* by the postfloration of its petals, the two borders of which roll inwards, whilst that of *Silene* is shrivelled and contorted.

A Plumbagineous plant has been alternately described under the names of *Plumbago Larpentæ* and *Valoradia plumbaginoides*. It presents the same postfloration as *Plumbago*, namely the rumpled arrangement of the limb of the corolla, which is in favour of its being united with that genus.

The postfloration of the stamens deserves a special study. It is remarkable in the genus *Aloë*, in which the filaments become undulato-crispate in consequence of an unequal shrinking of the tracheal system and of the long cells which surround it. The three first-formed stamens become shrivelled before the others.—*Comptes Rendus*, 26th Dec. 1865, pp. 1177–1179.

Observations on the part played by the Nucleus in Animal Cells. By M. Balbiani.

In 1864 the author detected in the ovules of several animals certain transparent cavities or vacuoles seated in the germinal spots,

and endowed with alternate movements of contraction and expansion. He has since succeeded in observing the contractions of the spot in the living animal. Notwithstanding the analogy which these phenomena present to those observed in the Infusoria and Rhizopoda, their signification remained obscure until the acquisition of a better notion of the morphological condition of cells. Thus the movements of the germinal spot could not be assimilated to those of which the contractile vesicle of the animals just mentioned is the seat, as in the ovules and other cells of animals we were unacquainted with any canals comparable to those connected with the contractile vesicle of the Infusoria. These the author now professes to have discovered, from which he considers we are justified in assuming the existence of a true circulation in these elementary parts of the organism.

The animal on the ovule of which the author's observations were made is *Geophilus longicornis*. When the fresh ovary of this Myriopod is placed under the microscope, and the ovules are examined through its walls, an organ is detected which possesses more brilliancy than the surrounding vitellus, and appears like a prolongation of the germinal vesicle. With slightly acidulated water this appears distinctly as an infundibuliform canal, more or less recurved, of which the wider orifice is continuous with the membrane of the vesicle, whilst the opposite extremity reaches the surface of the vitellus. Generally the canal seems to terminate suddenly at this point, opening by a circular orifice under the envelope of the ovule; but sometimes it appears to be continued into a delicate prolongation, emitting ramifications which spread more or less over the surface of the vitellus. In certain positions the axis of the canal is seen to be occupied by a much narrower interior canal, proceeding from the germinal spot and narrowing rapidly after penetrating into the outer canal.

The germinal spot is occupied by a greater or less number of vacuoles, capable of alternate contraction and expansion. At the moment of the extreme expansion of one of these vacuoles its walls appear to be directly continuous with those of the canal which terminates at the spot, the vacuole then looking like the enlarged ampulliform end of the latter. When less dilated and seen in profile, it appears only to communicate with the canal by a narrow aperture like a pore.

The width and apparent length of the two canals are in relation to the degree of development of the ovules; but they are to be seen in the youngest. In older ovules they continue visible as long as their transparency is not obscured by vitelline elements; and they probably persist as long as the germinal vesicle and spot.

In seeking for similar structures in other ovules, the author arrived at the following results:—In the ovules of the Bitch the vesicle and spot each present a canal, as in *Geophilus*. In the Skate, the ovules of which usually contain from one to four small germinal corpuscles with a central vacuole, each of these emits a variable number

of small canals (usually two to four), which traverse the cavity of the vesicle in different directions, pierce its wall, and lose themselves in the surrounding vitellus.

In the bony fishes and Batrachia, in which there are a great number of germinal spots adherent to the inner wall of the vesicle, and the latter is surrounded by a system of canals radiating towards the surface of the ovum. Each canal is connected with one of the spots.

Multiple canals are generally met with in all ova which present more or less numerous germinal spots. Sometimes, as in some Crustacea (Crayfish, Shore-crab), these multiple spots appear also to be united to each other in the interior of the vesicle by canals.

In many Annelides, Turbellaria, Mollusca, and Acalephs the ova contain only a simple germinal spot, often of considerable size, connected with a single canal, which is enclosed in a second canal, starting from the vesicle. The germinal spot also very commonly contains one or more large vacuoles possessing a very manifest contractile power (*Helix, Prostomum, Vortex*, &c.).—*Comptes Rendus,* December 26, 1865, pp. 1173–1177.

On the Lateral Canal of Lota.
By Professor Hyrtl.

The lateral canal-system of this animal possesses no orifices in the skin on the lateral line, but forms a closed subcutaneous tube, supported by cartilage throughout its whole course, and which acquires a moniliform appearance in consequence of the presence of alternate wider and narrower spaces. The absence of lateral orifices enables us to inject this canal. By this means its cephalic ramifications are also demonstrable, and these have not yet been detected in their perfect connexion in any Teleostean fish. The canal reaches the occipital region of the head above the *suprascapula*, and is there connected by a wide anastomosis with that of the opposite side; it then runs above the eye to the nose, where it becomes suddenly narrowed, and opens externally upon a capillary papilla in front of the nasal aperture. During its course to this point it emits, behind the eye, a large branch downwards; this passes forward round the orbit, emits three cæcal diverticula upon the suspensorium and to the articulation of the lower jaw, and terminates cæcally beneath the nasal pit, forming a series of ampulliform dilatations. In front of the eyes the two lateral canals are united by a short transverse duct, which forms a spherical dilatation (alveus communis) in its middle, and close to this emits a blind diverticulum upon the anterior frontal bone. When the canal is injected in a backward direction, we discover that it has also a posterior terminal aperture, which, like the anterior one, is to be seen upon a minute cutaneous papilla, about an inch from the caudal fin. The canal-system of both sides of the body has consequently only four cutaneous apertures.—*Anzeiger der Akad. der Wiss. in Wien,* May 11, 1866, p. 119.

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XXXIV.—*On the Habits of the* Prisopi. By ANDREW MURRAY, F.L.S.

THE few entomologists who have studied the Phasmidæ ("leaf-insects" and "walking-sticks") are familiar with the remarkable form and organization of the *Prisopi*; but, although that genus has occupied the attention of such acute entomologists as Stoll, Burmeister, and Blanchard, and more recently been monographed and its structure figured by that prince of entomological draughtsmen, Westwood, no suggestion has ever been made or explanation offered of the purpose and meaning of their singular organization.

It is not long since I obtained satisfactory information on this point from my friend Mr. Alexander Fry; and as he is too much occupied at present to publish it himself, and I think it too interesting to be kept back, I, with his permission, send you this account of what he knows on the subject.

It only relates to the species named *Prisopus flabelliformis*, a specimen of which he had obtained while in Brazil; but as all the species are characterized by the same peculiarities of structure, the habits of one will doubtless be the habits of all.

I may premise that Mr. Fry has the fullest confidence in the veracity of the person from whom he received the information, who moreover had no temptation to deceive him, and was, besides, too little acquainted with entomology to know that he was solving an entomological puzzle. The habits which he ascribes to the *Prisopus*, too, are not such as would readily occur to a romancer to endow a flying insect with, although, as it turns out, the structure is so admirably adapted to the purpose explained by him that it seems a wonder that the very perfection of its adaptation did not suggest to entomologists what the purpose was.

According to this observer, then, the insect was obtained by

him in the mountains of Brazil; and its habits were to spend the whole of the day under water, in a stream or rivulet, fixed firmly to a stone in the rapid part of the stream, but on the approach of dusk to leave the water and to sally forth into the night air on its own affairs, one of which undoubtedly would be to search for its lady love, whom it is reasonable to suppose we already know under some other form and described under some other name—judging, at least, from other Phasmidæ or leaf-insects, the perfect male of which has usually ample wings, while the female is not so well provided with organs for flight.

The creature is a large orthopterous insect, with wings of unusual dimensions and, the under ones especially, of fine membranous texture, apparently by no means well adapted for an aquatic life. And yet we shall presently see they are so arranged that they can be folded up exactly like a well-cared-for umbrella, placed under the protection of a waterproof cover.

Before passing the structure of the little creature under review and pointing out how thoroughly each part of it is fitted to the unusual mode of life ascribed to it, we may first pave the way by reminding the reader that this is not the only winged insect which has been ascertained to pass a great part of its life under water. Stoll figured a singular species, which Westwood* thinks belongs to the family of grasshoppers (Gryllidæ), under the name of the "Grillon aquatique cornu" (*Henicus Stollii* of G. R. Gray); but Westwood adds that "it is quite evident, from the saltatorial structure of the legs and the impossibility of the insect executing a leap under water (from the natural resistance of the element), that there must be a mistake in the statement that it is aquatic in its habits."

If I might hazard a conjecture on the subject, it would be that Stoll, who also describes our *Prisopus*, had received a true account of its habits, but had confounded it with the "aquatic cricket," and transferred the story from the one insect to the other. This is the less unlikely since we know that he had both in his cabinet.

More recently Mr. Lubbock described to the Linnean Society two aquatic Hymenoptera of small size, which he had observed in a basin of pond-water. "Though most of the great orders," says he, "are more or less richly represented (in water), no aquatic species of Hymenoptera or Orthoptera had till now been discovered. . . . . Great, therefore, was my astonishment, on the occasion to which I allude, when I saw in the water a small Hymenopterous insect, evidently quite at its ease, and actually

* J. O. Westwood, Modern Classification of Insects, i. p. 456.

swimming by means of its wings. At first I could hardly believe my eyes; but having found several specimens, and shown them to some of my friends, there can be no doubt about the fact"*.

For an account of the structure and economy of this wonderful creature, as well as of another similar species found at the same time, which, although living under water, does not use its wings, but its legs, for swimming, I must refer the reader to Mr. Lubbock's paper. I shall only observe that, although the wings in both are largely ciliated or fringed with hair, they are not more so than the wings of their terrestrial allies. As Mr. Lubbock says, "There is nothing in their structure to suggest the idea that they are aquatic."

Not so with our species when it is fairly examined with reference to its supposed habits and means of carrying them out.

The whole underside, even the head, is hollowed out like the half of a reed. The surface of that side is flexible, smooth, and finely polished. The margins are thinned off, and the segments of the abdomen, where not fitted to the posterior legs, are provided with flaps or quasi claspers. All the legs fit most beautifully and closely to the side of the abdomen. Their outer margin is dentate and provided with a thick fringe of hair, which, like the feathers of a duck, repels water. Moreover at the knee-joint, where there is unavoidably an opening or unprotected space, it is provided with a flap or side knee-pan—a provision which occurs in no other insect with which I am acquainted. This flap hangs down, filling up the opening, and is furnished, like the rest of the outer margins of the leg and body, with a supply of hair impervious to water. The posture of the animal in the water is, fastened to the upper surface of a stone, and with its head turned up stream in opposition to the current. It sits with its fore legs extended forwards in front of the head, and the inner side of the thighs is hollowed out exactly to fit the sides of the head, and the thigh itself is bent down so as to form the continuation of the sides of the long cup or saucer which the underside of the animal represents. The antennæ fold back on the upperside of the head, where there is a depression to receive them. In the other Phasmidæ the tegmina or upper wing-cases are usually short, narrow, and coriaceous, and apparently not fitted for much use. Here they are as long as the body, so as to cover the whole of the large under wings when folded up; they are broad enough to do so; and the whole are only of a semicoriaceous texture, flexible and pergaminous, but most so at the base, thinning away at the termination into a

* Trans. Linn. Soc. xxiv. p. 135.

finer texture, approaching that of the lower wings. The claws of the tarsi are strong, powerful, and well adapted for clinging.

In this animal we seem to have a combination of two plans of adhesion: there are the claws and claspers and flaps for holding on by; there is the hollow underside for adhering by exhausting the air between it and the stone it clings to, on the principle of the air-pump. If, when it settles on the stone and adjusts itself, its tracheæ are full of air, and it then expels the air and by muscular power draws in the skin of the abdomen and underside generally, it must, of course, leave a vacuum, and consequently adhere like a sucker.

This species from the mountains of Brazil is the only one of whose aquatic habits any account has been received; but the genus, although individuals are rare (as with most species which only show themselves at night), is widely distributed.

The following are the species known up to the present time, with their localities, taken from Westwood's recent Monograph of the Phasmidæ:—

Prisopus flabelliformis, Stoll.	Brazil; Cayenne.
—— *spiniceps*, Burm.	Do. do.
—— *Ohrtmanni*, Licht.	East Indies.
—— *horridus*, Westw.	Columbia.
—— *Horstokkii*, De Haan.	Cape of Good Hope.
—— *berosus*, Westw.	Panama.
—— *phacellus*, Westw.	Brazil; Ega.
—— *incertus*, Westw.	Samarang; Java.
—— *cornutus*, G. R. Gray.	India.
—— *cepus*, Westw.	Bolivia.
—— *Guerini*, Westw.	Ile Maurice.

Now that their habits are made known, we may expect that specimens will become less rare, and that we shall receive more information regarding their economy and mode of life.

XXXV.—*On Two European* Argulidæ, *with Remarks on the Morphology of the* Argulidæ *and their Systematic Position, together with a Review of the Species of the Family at present known.* By T. Thorell.

[Continued from p. 169.]

III.

As the question of the position which the family Argulidæ should occupy in the system of the Crustacea is far from having received a satisfactory solution, it will not be out of place here to dwell somewhat further on this subject. Referred by Linné

to the genus *Monoculus* (which corresponds with almost all the lower Crustacean orders or "Entomostraca" with the exception of the Cirripeds), the sole representative of the family Argulidæ then known (*A. foliaceus*) held a place in the 'Syst. Nat.' ed. 10, between *M. polyphemus* and *M. apus*, consequently between a *Limulus* and an *Apus*. In the 'Fauna Suecica,' ed. 2, a *Caligus* (*M. piscinus*, L.) was located between *Argulus* and *Apus*. In the 'Entomostraca' of Müller*, who first erected the genus *Argulus*, we find it between *Polyphemus* and *Limulus*, immediately after which comes the genus *Caligus*.

From this time, however, it gradually became general to place *Caligus* and *Argulus* near to each other, especially since Latreille laid the foundation of the present prevalent division of the class of Crustacea, and constituted the order Siphonostoma for those forms which are provided with sucking-tubes, placing therein the genera *Argulus* and *Caligus* in close proximity to each other. This view of the systematic position of the Argulidæ has been shared by most of the more modern authors, as Burmeister, Milne-Edwards, Baird, Dana, Heller, Cornalia, Claus, Kröyer, &c. As Latreille's *Siphonostoma* and Milne-Edwards's *Lernéides* have been united with that author's *Copépodes* in a single order by Zenker†, under the name Entomostraca, called *Copepoda* by later authors, it is consequently among the parasitic suctorial Copepoda (Copepoda siphonostoma) that the nearest affinities of the Argulidæ have been sought. But this view of the affinities of the Argulidæ has been by no means generally accepted: from more than one quarter have objections to it been put forward, which render necessary a further examination of the reasons alleged in favour of it. Dana and Herrick have already pointed out the great differences between the oral organs of the Argulidæ and the true Siphonostoma, and express their opinion that *Argulus* should perhaps hereafter become the type of a new order, standing between the Siphonostoma and the Pœcilopoda or Xiphura. Their attempt to show a nearer relationship between the Argulidæ and these last must, however, be regarded as abortive, since it is pretty generally recognized that such conditions of organization as may ally the Argulidæ to *Limulus* are presented in a still more marked degree by the Phyllopoda, especially the genus *Apus*. *Limulus* shows, moreover, so many remarkable peculiarities in its structure, that it must necessarily be regarded as the type of a separate order, in spite of its being more nearly related to the Branchiopoda and

* Entomostraca seu Insecta testacea, quæ in aquis Daniæ et Norvegiæ reperit, &c. O. F. Müller (1785), p. 121.

† Untersuchungen über die Organisation und Verwandtschaft der Copepoden, p. 54.

Argulidæ than to any other group of the Crustacea. Even Vogt expresses himself against the union of the Argulidæ with the Siphonostoma, on the ground that the organization of the mouth is very different; but he says nothing further as to their place in the system.

The order Branchiopoda only can claim a stronger affinity to the Argulidæ on the ground of several leading points of resemblance. The relation of these latter to that order had already attracted the notice of authors who ranged them with the Siphonostoma, as, for instance, Milne-Edwards, who says, with reference to the swimming-feet of the Argulidæ, that they seem to be intermediate between those of the Branchiopoda and of the ordinary Siphonostoma. Zenker is, however, the first who made a decided step in this direction, and in his Crustacean system united them with the Branchiopoda, at the same time drawing attention to their marked agreement with these in certain important points, as the structure of the eyes and digestive apparatus, and showing also that the greater number of the characters which were thought to justify their amalgamation with the Copepoda are also to be found in many Branchiopoda. This notion of Zenker as to the systematic position of the Argulidæ has been shared by Gegenbaur and myself*, as also by Steenstrup and Luetken, who ally *Argulus* to the Phyllopoda, as the representative of parasitism in that group.

A renewed examination of the structure of the Argulidæ, as compared with that of the Copepoda and the Branchiopoda, has further convinced me of the correctness of Zenker's view. I have fancied that I could discover grounds for making the Argulidæ a suborder of the Branchiopoda, consequently *a group of equal value with the Phyllopoda and Cladocera,* although most nearly allied to the former; and as I shall now proceed to an exposition of those grounds, I have only to hope that such may in some measure contribute to the final solution of the question. Such an examination has appeared to me all the more necessary since Kröyer has lately become a champion of the old view of the position of the Argulidæ, and has sought to prove their affinity with the Copepoda by several considerations which have been more or less overlooked by previous authors, who founded their ideas of the propriety of inserting the Argulidæ among the parasitic Copepoda exclusively on the suctorial formation of the mouth and the parasitic habits depending thereon.

In order to form a clear notion of the relations of the Argulidæ to the Copepoda and Branchiopoda, it is necessary to determine the reciprocal relations of these two groups; *i. e.* to

* "Bidrag till kännedomen om Krustaceer, som lefva i arter af slägtet *Ascidia*, L.," K. Vetensk.-Ak. Handl. Bd. iii. No. 8 (1859–1860), p. 14.

define what is common to both types and what are the principal characters which authorize their position as two distinct orders in the class, and then to see in what respect the Argulidæ assimilate to the one or the other group, or differ from both. We will, in passing, merely recall the common bond which unites all the lower orders of Crustacea, Xiphura, Branchiopoda, Ostracoda, Copepoda, and Cirripedia, and which seems to us to warrant the union of these orders into one large subclass, Entomostraca, in Latreille's acceptation of that term, in contradistinction to the other, higher Crustacean orders, or Malacostraca. The Xiphura incline towards the Phyllopods in the order of the Branchiopoda, with which Zenker was disposed to unite them; the near affinity of the Ostracoda with the Cladocera is pretty generally recognized; moreover they are often placed in close connexion with the Copepoda; and these latter show not only a great affinity with the Ostracoda, but also with the Cirripedes on the one side, and the Branchiopods, especially the Phyllopods, on the other.

This near relation of the Copepods and Phyllopods shows itself especially in their development. In both groups, the larva, as far as is known, always goes through a *Nauplius*-stage, and then shows three pairs of extremities of which the first two develope into the first and second pairs of antennæ, the third into the mandible and its palp when such exists. The body is always (except in the lower parasitic Copepods) conspicuously segmented; the oral organs consist, when complete, of four pairs of appendages—one pair of mandibles, one pair of maxillæ, and two pairs of foot-jaws. The feet are cloven or lobed swimming or respiratory organs. The Cladocera differ in their indistinctly segmented trunk, and in the fact that they go through the metamorphoses which correspond to the *Nauplius*-stage in the egg, and thus *do not* go through a (true) metamorphosis. In this respect they approach the Ostracoda. The development of the Argulidæ is midway between that of the Phyllopods (and Copepods) on the one side, and that of the Cladocera (and Ostracoda) on the other: their larvæ go through the earlier phases of the *Nauplius*-stage in the egg-shell, and quit this in a form which most nearly corresponds with what Claus calls the final *Nauplius*-stage of the Copepoda; whence the metamorphoses of the Argulidæ, as compared with those of the Phyllopods and Copepods, may be called *incomplete*. For the rest, we find in the Argulidæ also those characters which we have mentioned as common to Phyllopods and Copepods.

If we would determine by what characteristics the Copepods and Branchiopods may always and with certainty be distinguished from each other, we cannot at the outset fail to per-

ceive that the former constitute a much compacter whole than the latter, and that certain conditions of organization which in the one type (that of the Copepoda) show a considerable degree of constancy are in the other exceedingly variable. Thus the number of body-segments in the Copepods varies within comparatively narrower limits than in the Branchiopods; and the same thing is the case, and in a higher degree, with the number of the legs. Since the trunk in Copepods always bears a definite number, at the most (and most frequently) five pairs, of extremities, it would be an extremely remarkable variation if a form appertaining thereto were detected with more than five pairs of legs; whereas it is not at all surprising to meet among the Branchiopods, which certainly are generally distinguished by numerous extremities, with forms possessing only a few pairs of legs (as, for instance, four in the Argulidæ), while their number varies in the Phyllopods from ten to sixty, and in the Cladocera goes down to six, five, or only four pairs.

The oral organs also are more constant in number in the Copepods than in the Branchiopods, where the maxillary feet are mostly rudimentary or entirely wanting. Even in cases where both pairs are found, as in *Apus*, the posterior are always rudimentary—a condition which is seldom observed in the Copepods. Amongst these it is usually only in connexion with parasitic habits that the number of the oral organs is reduced; but it is here worthy of remark that *the parasitic nature in general occasions a stronger development of the maxillary feet, and always in those groups at least which possess suctorial tubes and distinctly segmented bodies* (i. e. Ascomyzontidæ, Caligidæ). This would lead us to suppose that if parasitic Branchiopoda be found analogous to the Copepod families just named, the maxillary feet of these, as constituting the seizing-organs already mentioned, will also have received a stronger development than in the free forms. Notwithstanding, therefore, that the Argulidæ possess, as is well known, in correlation with their parasitic habits, particularly strong maxillary feet, this character would not forbid their approximation to the Branchiopoda on the ground of their further agreement with that group.

In the Copepoda both mandibles and maxillæ are usually furnished with a palp, whereas this is never the case in the Branchiopod order, excepting in the genus *Nebalia*, which differs in so many respects from them, and makes an approach to the Decapoda (*Mysis, Cuma*). In Copepods the palpi are certainly sometimes wanting, especially in the parasitic forms; but in the higher Siphonostoma (Ascomyzontidæ and Caligidæ) there is generally at least *one* pair, while these organs are altogether wanting in the Argulidæ.

Here it will be proper to make the two following remarks:—

In the parasitic suctorial Copepoda, the tube never contains more than one pair of organs, the mandibles; in the Argulidæ, on the contrary, most generally two pairs, both maxillæ and mandibles, and these in form quite unlike the small saw- or lancet-like mandibles of the Siphonostoma.

In the parasitic Copepoda it is always the antennæ of the *second* pair which are used as seizing-organs; in the Argulidæ, on the contrary, it is the *first* pair which performs this function.

As something peculiar to the order Copepoda, the form of the *limbs of the trunk* holds a prominent place. These consist, as we know, of a basal piece, composed of two joints, with two branches situated on this, each consisting of three joints. Generally the feet belonging to one pair are united by means of a *median plate*, so that they move in unison. The structure of the legs may perhaps be simplified by certain parts becoming fused together or further separated; but whenever the legs attain a full development, they present the form here described. Such is also the case with the parasitic forms—as, for instance, the Caligidæ. In the Branchiopoda the structure of the legs is highly variable, but is still referable to a common type: it is sufficient to notice here that they never have the form characteristic of Copepoda, and that the *median plate is always absent*. This is also the case in the Argulidæ, whose swimming-feet, as we shall show further on, admit of an easy comparison with the feet in *Apus*. The presence of "branchial appendages" on the feet of the Branchiopoda is not a thoroughly constant character in this order: they are wholly rudimentary or completely wanting in many Cladocera, as *Polyphemus, Podon, Evadne, Bythotrephes, Leptodera*, on the extremity of the tail in *Nebalia*: consequently the absence of such appendages in an animal (as in *Argulus*) does not show that it cannot belong to the Branchiopoda.

Almost as distinctive of the Branchiopoda as the form of the feet in the Copepoda is the structure of the *visual organs* in the former as compared with the latter. The Branchiopods have two large, generally moveable, lateral eyes (in the Cladocera these coalesce into a single eye), composed of numerous crystalline cones, with the cornea at least externally unfacetted. No Copepod has eyes that can be fully compared to these; for the median single eye in the Copepod, which often contains two or more crystalline bodies, corresponds to the ocellus situated behind the lateral eyes in the Branchiopoda, and sometimes also provided with crystalline bodies; and the large paired eyes in certain Copepods (as the Pontellidæ and Corycæidæ) show a structure entirely different from the compound eyes of the Branchio-

poda, if indeed they morphologically correspond with these. The eyes in *Argulus* are moveable, and agree in their structure, as is well known, with those of the Phyllopods in their most sharply defined form.

In the Copepoda we never meet with the *shell armature* which, as a kind of supplementary integument on the anterior divisions of the body, in the Branchiopoda so generally encloses or covers the body. The large *shield* in the Argulidæ shows the greatest resemblance to the carapace in *Apus*, and removes them far from the Copepoda.

With regard to the *internal structure*, this in many instances affords a more uncertain criterion for judging of the affinity of the lower Crustaceans than do the characters which are drawn from their external form. Thus the nervous system, the circulatory apparatus, &c., in nearly related forms, may show very striking discrepancies, to adduce an instance of which we will only mention the known fact that, even in the strictly natural group formed by the gnathostomous Copepods, the Calanidæ and Pontellidæ possess a heart, while the nearly allied Cyclopidæ, with others, want a definite central organ of circulation. At the same time, however, that the internal structure presents such extraordinary variation and inconstancy even in the most nearly related groups, it shows, on the other hand, in its general features such striking correspondences in the Branchiopods and Copepods, that it is difficult to fix any anatomical character as belonging to one only of these two orders. The *generative apparatus* in the Copepoda only furnishes two peculiarities which are worth noticing here. The *eggs* are united in the Copepoda, when they leave the ovaries, to form one or two *external egg-sacs*, excepting in the spurious parasitic Notodelphyidæ and Buproridæ, in which they are received into a *matrix*, almost as in the Cladocera. In the Branchiopoda such egg-sacs are *never* present. In the Copepoda, impregnation takes place, as far as we know, always by means of *spermatophores*, which are attached externally to the body of the female close to the sexual orifice or the mouth of a separate canal leading to the receptacle. The Branchiopoda *never* show such spermatophores. In both these points the Argulidæ depart from the Copepoda in general, and from the analogous forms in that order, Caligidæ and Ascomyzontidæ in particular, in that they lack both egg-sacs and external spermatophores.

Notwithstanding the agreement which the Argulidæ present with the Branchiopoda in respect to conditions of propagation, they yet exhibit in this very direction both peculiarities and analogies with other orders. Zenker has already pointed out this: in respect to the form and products of its generative ap-

paratus, he says that *Argulus* makes a nearer approach to the Ostracoda "in its thread-like zoosperms and the existence of male accessory glands and of female seminal receptacles." He might have added that they here also approach the Copepoda, which are also sometimes furnished with thread-like zoosperms (I myself have observed them in *Lichomolgus*); accessory glands are often met with in connexion with the male organs, and a single or double receptaculum seminis apparently always, in the Copepoda. Resemblances in these particulars, with the exception of the last named, are, however, relatively of little weight. Meanwhile the generative apparatus in the Argulidæ is referable, as we have seen, in certain points to the Branchiopods, in others to the Copepods. But conditions in the highest degree peculiar separate them from both these orders. Unfortunately, much respecting the propagation of the Argulidæ remains still obscure; and even Leydig's accurate researches on this subject* leave many important questions unanswered. The signification of the characteristic (probably copulatory) appendages on the two or three posterior pairs of swimming-feet is undetermined, with the exception of the capsule on the hinder part of the third pair of feet, which, according to Leydig, is filled with sperm from the opening of the ductus deferens, and afterwards, during the act of copulation, presses its contents into the seminal reservoirs. The function which belongs to the "hook" on the last pair of legs, which in its structure so strongly recalls the copulatory organ of the Spiders and *Julus*, is unknown. Leydig perceived only that during copulation this was "closely pressed upon or into the capsule of the last pair of legs but one," and that it did not serve in any way to retain the female. This latter function may perhaps belong to the projections on the hinder part of the second pair of legs, which occur in certain species, as *A. coregoni*. As to the significance of the projections on the fore part of the third pair of feet, I do not venture to guess.

The females of the Argulidæ have, as has been said, two receptacula seminis, which, each by means of a proper channel of communication, opens out on a moveable papilla near the underside of the tail, behind the mouth of the ovarium; and thus it would seem that an immediate connexion between the receptacles and the ovarium is here wanting. How the semen under these conditions can come into contact with the eggs is still undiscovered.

Another circumstance also brought to light by Leydig (with reference to *A. foliaceus*) is of the greatest interest. "The receptacle is," he says, "in females which have never copulated, empty and folded inwardly. After copulation there appears in-

* Ueber *Argulus foliaceus*, p. 339 &c.

side this another stout vesicle, which is filled with spermatozoids. A homogeneous sharply defined thread shows itself as a continuation of the skin of this enclosed vesicle, through the outlet, to a papilla situated in a concavity." On the nature of this bladder nothing is said. But may we not see in this a *spermatophore* which is not, as in the Copepods, attached externally to the body of the female by means of a tubiform filament through which the spermatozoids pass into the receptacle, but which is altogether introduced into this latter? And if this supposition be correct, where is the spermatophore produced? Possibly, may we not think, in the capsule on the third pair of legs, whence it must be supposed to have become transferred to the receptacle? in effecting which the "hook" on the last pair of legs would certainly play an important part. Or may not the two accessory glands which open each upon the lower portion of its own ductus deferens contribute the secretion to form the walls of the spermatophore? And how can the spermatozoids escape from this bladder or spermatophore if the channel of communication be filled up by a "homogeneous thread"?

I have dwelt upon these circumstances chiefly with a view to drawing to them the attention of those who have opportunities and inclination to accord them a due investigation in living Argulids. Especially suitable for such researches is the large *Argulus coregoni*, which would seem to be tolerably frequent in the larger lakes of Sweden.

Proper to the Argulidæ is moreover the circumstance that the eggs come directly from the ovarium into freedom: they are neither retained in a "uterus," matrix, or any structure analogous thereto, as is the case in most Branchiopoda; nor are they attached to the projection of some of the legs, as in some forms of this order. (See what we have said concerning the ovarium of *A. coregoni*, p. 168.) This is, however, of subordinate importance. The ovarium of *Argulus* may be regarded as corresponding to both uterus and ovarium in, for example, *Branchipus*, forming, however, a single structure, in which the portions set apart for the producing of the eggs and for their maintenance have not yet become separated in position from each other.

The remaining peculiarities which the sexual apparatus of the Argulidæ presents are not of very great importance, and are always easily reducible to conditions commonly prevalent in the Branchiopoda. They are mostly to be accounted for by the fact that the tail is sharply separated from the trunk, whence also the various parts of the sexual apparatus are more separated from each other. Thus the ovarium is situated entirely in the trunk, while the receptacles are in the tail; the testes are placed

here, while the seminal bladder and ductus deferentes lie in the trunk. In the Branchiopods both ovarium and testes have their position in the anterior portion of the tail *.

While we are on the subject of the sexual conditions of the Argulidæ, we must not omit to mention a circumstance which in some measure removes them from the Branchiopoda: propagation by means of *parthenogenesis*, which seems to be so general in that order, seems to be as rare among the Argulidæ as among the Copepoda.

Among the anatomical characters whereby the Copepoda may pretty constantly be distinguished from the Branchiopoda, it has been asserted, is the *absence of gall-secreting branches in the intestinal canal*. However, according to Claus, many Copepods, especially the genus *Sapphirina*, possess extremely strongly developed glandular liver-appendages; and since these in many Branchiopoda (as, for instance, the Branchipodidæ) are but feebly developed or (as in *Limnadia* and many Cladocera) altogether wanting, we must not attribute to this character any special importance. Still the strong branches of the intestinal canal beneath the head-shield in *Apus* and *Argulus* certainly afford further grounds for considering that these creatures are nearly related.

Neither in the nervous nor circulatory system do I find any characteristics which might contribute to fix the line of demarcation between the Branchiopods and Copepods. The copious supply of blood in the head-shield in *Argulus*, which Zenker regards as attesting the Copepod nature of the Argulidæ, depends only on the strong development of this shield, the form of which meanwhile points, as has already been said, to a near relation with the Branchiopoda. According to Leydig and Claus, blood-corpuscles *are wanting* in the nourishing fluid of the Copepoda, but are found in both Phyllopoda and Cladocera, as also in *Argulus*. This difference, however, is not constant; for they are found also, according to Dana, in abundance in the Caligidæ in the first-named order. The well-marked separation of the tail from the trunk, and its *modification as a respiratory organ*, would seem to be the most prominent feature in their

* Leydig, "Ueber *Artemia salina* und *Branchipus stagnalis*, Beitrag zur anatomischen Kenntniss dieser Thiere," Zeitschrift für wissenschaftliche Zoologie, Bd. iii. p. 297 &c. Leydig is guilty of a misrepresentation when he says that Joly did not perceive the true ovaria of *Artemia salina*, but only the uterus, which he mistook for the ovary. Joly expresses himself thus:—"Sur les parties latérales des deux premiers anneaux de l'abdomen on s'aperçoit . . . deux sacs allongés, cylindriques, dont le fond est tourné du côté de la queue. *Ces deux sacs sont les ovaires proprement dits.* Ils viennent déboucher dans une matrice ou ovaire externe, qui paraît être une dilatation considérable de leur propre membrane."

entire organization. Leydig appears to be the first who recognized in the tail-fin of the Argulidæ their principal and proper respiratory organ, at the same time admitting that, as in the lower Crustacea in general, respiration is here also effected in a great measure by the thin integument of the body, especially on the large membranous head-shield *. Of some use for respiration are perhaps also the small leaf-like appendages which are sometimes developed (as in *A. purpureus*, and, according to Kröyer, in *Gyropeltis longicauda*) on the final segment of the trunk, and which seem to be analogous to the leaf-like dorsal plates in the Pandaridæ. The posterior surface of the last pair of legs is often more or less flattened out and widened; but this widening cannot functionally or morphologically be compared with the so-called branchial appendages on the extremities of the Branchiopoda. For the rest, the legs of the Argulidæ lack any trace of such appendages, but in other respects do not differ much from those of the Branchiopoda; and as it is with the Phyllopoda amongst these that they most agree in general habit, so it is accordingly the extremities of these which are most like the swimming-feet of the Argulidæ.

In order, however, not to overlook this likeness, we must not select for comparison such extremities as, by their conversion into "respiratory feet," have lost the typical form of organs of locomotion, but such as still present this form fully and completely. This is especially the case with the first pair of feet, or the so-called swimming-feet, in *Apus*. They consist (in *Apus cancriformis*) of a three-jointed prolonged basal part, which at its extremity bears three long, inconspicuously jointed *swimming-branches* or flagella). These parts evidently correspond both in form and function to the three-jointed stem of the feet in the Argulidæ, together with the swimming-branches and "flagella" attached to the end of this. The sole difference is that this "flagellum" in the Argulidæ is bent upwards and inwards; but even this is not always the case; for in *A. funduli* it is, according to Kröyer, directed similarly to the two swimming-branches. Sometimes the flagellum is wanting, as in *A. purpureus*. The two branchial appendages on the upper surface of the foot in *Apus*, as also a pair of flagelliform appendages situated on their lower surface, together with the so-called *masticatory piece* at their base, are, however, entirely wanting in the Argulidæ: the supposition that the flagellum in these corresponds to the branchial appendage of the Branchiopoda is consequently incorrect—a point which not only its attachment but also its form evidently show. Moreover the parts just mentioned are easily recognizable on the following pairs of feet

* *Loc. cit.* p. 338.

in *Apus*; but as the swimming-branches become gradually shorter and broader, while the branchial appendage proceeds in development, the likeness in form which the first pair of feet so strikingly shows to the swimming-feet of the Argulidæ decreases gradually with the likeness in function.

We may now pass on to a nearer examination of the grounds on which Kröyer* sought to prove that the Argulidæ are siphonostomous Copepoda most nearly related to the Caligidæ. His first argument is that *Gyropeltis* presents a transition between these two families in "certain essential particulars;" by which is meant that the species of that genus *lack* a *sting*, and have the first pair of foot-jaws of a *hooked form*, not developed into *sucking-cups*. To this it may be objected that the "sting" and sucking-cups are altogether peculiar to the Argulidæ: they neither occur again in Branchiopoda nor in Copepoda; and thus *Gyropeltis* might as well be said to form a passage to the *Apodidæ*, for instance, in the former order as to the Caligidæ in the latter, on account of its wanting these structures. Through the discovery of *Gyropeltis*, only two of the characters on which it would be possible to base the position of the Argulidæ as a separate order have lost their importance, inasmuch as they cease to be constant; but no reason whatever for the union of these animals with either of the two orders in question has hence been obtained. With respect moreover to the distinct form of the first pair of foot-jaws, these organs in *Gyropeltis* have only remained at that stage which belongs to *Argulus* in the larval condition.

Another reason for his view of the relation between the Argulidæ and the Caligidæ has been drawn by Kröyer from the structure of the *antennæ*: he endeavours, in fact, to identify the first pair of antennæ in the former with the second pair in the latter, on the ground of their functional agreement as fixing-organs. We have already had occasion to point out, on the ground of their development, the incorrectness of this view of their relations; and the Argulidæ demonstrate, in the fact that in them not the second, but the first pair of antennæ have become the fixing-organs, that they are widely separated from the Caligidæ and the other parasitic Copepoda. Kröyer further tries to show that *Argulus*, like the Caligidæ, has *two* pairs of foot-

* *Loc. cit.* pp. 25–29. I have not been able to see the force of the following objection against Zenker's separation of the Argulidæ from the Siphonostoma:—"Zenker expresses as the result of his researches, that *Argulus* must either form a separate order or be united with the Branchiopoda. But, in admitting this alternative, he necessarily allows that if *Argulus* may not be united with the Siphonostoma, neither may it be enrolled amongst the Branchiopoda; else why think of erecting a new order for this genus?"

jaws. This we are the less disposed to dispute since we regard two pairs of foot-jaws as belonging typically to all the lower Crustacean orders; whence it follows that this character leaves quite undetermined the question to which of these orders the Argulidæ belong.

As we have already shown, Kröyer has mistaken these parts so far as to regard the second pair of antennæ as being the first pair of foot-jaws, and the sucking-cups, or the true first pair, as the second. Kröyer has further, by drawing a parallel between the tail in the Argulidæ and the *genital ring* in the Caligidæ, thought it possible to establish a nearer affinity between these families. I have already pointed out the incorrectness of this comparison, and endeavoured to show that the tail of the Argulidæ corresponds to the entire tail, inclusive of the genital ring, in the Caligidæ and other Copepoda. This, however, is altogether foreign to the question how far the Argulidæ are Copepoda or Branchiopoda. The Branchiopoda have a jointed or unjointed tail like the Copepoda; and in many Phyllopoda (as, for instance, *Branchipus* and *Artemia*) the first caudal segments are much more subservient to the office of generation than in the Copepoda and *Argulus*, since they contain, as already mentioned, both testes and ovaria. Even among the Cladocera, which otherwise, with few exceptions (*Leptodera, Bythotrephes*), resemble the Argulidæ in their unsegmented tail, we have an example of this in *Leptodera hyalina* (of which, however, the male is unknown), in which animal the *ovaries* at least are situated in the anterior tail-segments*.

Kröyer further asserts that, since it is now known that the "sting" does not belong to the mouth-tube, the oral organs of the Argulidæ offer no difficulty to their union with the Siphonostoma. We have, however, shown that the only resemblance between the oral organs in the two groups is that the mouth forms a sucking-tube, as is the case so often amongst the parasitic Articulata, not only among Crustacea of different orders, but also among Insects and Arachnids. That this character is of extremely subordinate value in the determination of the systematic position of the Crustacea is shown by the circumstance, among others, that we are forced to unite in the order Copepoda forms with free oral organs and forms with these enclosed in a suctorial tube. Zenker, who showed the necessity of this, rightly observes, with respect to Milne-Edwards's subclass *Crustacés suçeurs*, "Is the form of the mouth to be regarded as of such weight systematically in a case where parasitic habits call for and produce a certain determinate form dependent thereupon?

* Lilljeborg, "Beskrifning öfver tvenne märkliga Crustaceer of ordningen Cladocera," Œfv. af. K. Vetensk. Ak. Förh. 1860, p. 266.

Whether the animals be related or not, the structure of their mouth must necessarily be somewhat similar in appearance. Circumstances which are modified in correspondence with peculiar modes of life are not signs sufficient to determine original affinity; better as such are those taken from characters which are as far as possible independent of the peculiarities of habits and mode of life."

The presence, therefore, of a suctorial organ shows merely that *Argulus* is a parasitic Crustacean, but does not point out to which order it should be referred. With reference to the "sting," Kröyer says that it "assuredly corresponds to the poison-weapon in many of the lower Crustacea, both free-swimming Copepods (as *Cyclopsine castor*) and parasites, although peculiar both in form and position." As Kröyer here mentions *Cyclopsine castor*, which has no organ comparable to the sting of the Argulidæ, I suppose he means the so-called *shell-gland* (skalkörteln) which has not only been observed in *Argulus* and some Copepods*, amongst which is *Cyclopsine castor*, but which occurs generally in the Branchiopoda, both Phyllopoda and Cladocera†, in the Cytheridæ among the Ostracoda‡, and which is considered to be the same organ as that known as the *green gland* in Decapoda and Amphipoda. Meanwhile the determination of this "shell-gland" as a secretory and specially as a poison-organ is in the highest degree uncertain, and the more so since we do not as yet know for certain whether any channel exists in connexion with it. Zenker certainly insists that it opens externally in *Cythere* through a spine on the lower antennæ; and Kröyer has a similar suggestion where he says § that in the Caligidæ the claw on the second pair of antennæ "shows on the concave side very frequently (perhaps always) a bristle or fine spine, which seems to be connected with an extensive internal apparatus (gland, channel, and bladder)." But he continues thus:—"Whether this is to be referred to the category of the organs lately pointed out in many of the lower Crustacea, and designated *poison-weapon*, must be left undetermined," and adds that he "has often found a perfectly similar apparatus on the hooked second pair of feet,"—an addition which renders the propriety of a comparison with the "poison-organ" of, for instance, *Cyclopsine* very doubtful. *If*, meanwhile, these suggestions of Zenker and Kröyer are correct, and *if* the "shell-" or "poison-

* Zenker, "Ueber die Cyclopiden des süssen Wassers," Archiv für Naturgeschichte, xx. (1854) p. 98; also Claus, *loc. cit.* p. 60.

† Leydig, Naturgeschichte der Daphniden, p. 23 &c.

‡ Zenker, "Monographie der Ostracoden," Archiv für Naturgeschichte, xx. (1854) pp. 18 & 29.

§ *Loc. cit.* p. 105.

gland" in *Argulus* opens through the "sting," which has not yet been attested from observation, then it is only the spine just mentioned on the second pair of antennæ in the Caligidæ and Cytheridæ (consequently in animals belonging to two different orders) which can be compared with the sting in *Argulus*. As the "poison-gland" itself occurs in many widely separated orders, it is easy to see that its presence in the Argulidæ in no way points out their zoological affinity; and should it open through a *spine* in some parasitic Copepoda, these would be in the same relation to *Cyclops* and *Cyclopsine* (which lack such an organ) as that which the parasitic *Argulus with* sting bears to the free Branchiopoda *without* sting.

Kröyer produces two further reasons for his view of the systematic position of the Argulidæ, which it now remains for us to remove. The first is "the absence in Argulidæ of external egg-sacs—which finds its analogy in the genera *Notodelphys*, *Doropygus*, &c." It seems to us, on the contrary, quite obvious that the absence of external egg-sacs goes to prove that the Argulidæ are *not* Copepods, since these, with the exception of the Notodelphyidæ and *Buprorus*, generally *have* external egg-sacs, as is also the case in particular with the *Caligidæ and all the other Siphonostoma* with which the Argulidæ would be ranged *were* they Copepods. The asserted analogy is, moreover, very feeble; for in the Argulidæ the eggs stand on the ovary itself until they attain freedom, whereas in *Notodelphys* &c. they pass from the ovaries into a matrix comparable with the so-called uterus in the Branchiopoda, or, still better, with the matrix of the Cladocera.

Kröyer finds the last attestation of the Copepod nature of the Argulidæ in "the simple eyes placed in a triangular form, which recur not only in the free-swimming Copepods (*Sapphirina*), but also in the parasites in the larval state." With reference to this, we have only to remark that an unpaired eye, retained after the larval period, without or with two, three, or several crystalline bodies ("simple eyes"), is quite usual, not only among the Copepoda (where it generally constitutes the sole visual organ), but also among Phyllopoda, Cladocera, and other lower Crustaceans, and that consequently the presence of such an eye in *Argulus* in no way proves its relationship to the Copepoda. Further, Kröyer's representation of the structure of this single eye in *Argulus* is incorrect; for what he calls three simple eyes are in that animal a three-lobed prolongation of the brain itself, bearing a *pigment-spot*, in which not a trace of crystalline bodies or "simple eyes" is to be detected, at least in either *A. foliaceus* or *A. coregoni*. The unpaired eye in many Branchiopoda (as *Branchipus* and *Artemia*) also shows itself as such a pigment-

spot, placed on a perfectly similar trilobed projection from the brain-ganglion*.

We have now gone through the proofs which have been put forward by Kröyer as grounds for the union of the Argulidæ with the siphonostomous Copepoda, and shown, we hope, that not one of them can be regarded as in any measure convincing or decisive. We will now briefly recapitulate the results to which we have been led during the foregoing investigation, and thence arrive at the conclusion respecting the systematic position of the Argulidæ which those results seem to warrant.

I. The Argulidæ *correspond* with the *Copepoda generally,* besides such points of their organization as are *common to the Branchiopoda and Copepoda,* only in these particulars :—that

(1) The females possess *receptacula seminis*; and that

(2) Parthenogenesis seems never to occur.

II. But they *differ* from the *Copepoda generally* in the circumstance that

(1) Their limbs want the intermediate plate (mellanskifva), and do not show the form characteristic of Copepoda; that

(2) They have two moveable eyes composed of numerous crystalline stemmata in front of the unsymmetrical larval eye; that

(3) The integuments of the head are developed into a bipartite shield, very often covering the larger portion of the body; that

(4) The eggs are neither attached to external egg-sacs nor are received into a matrix when they leave the ovaries; that

(5) Impregnation is not effected by means of spermatophores attached externally to the body of the female; and that

(6) The larvæ leave the egg in a much more advanced state of development than in the Copepoda.

III. Meanwhile they *agree* with the (higher) *siphonostomous Copepoda* in certain particulars, which all, however, *depend upon their parasitic mode of life*: they have, for instance,

(1) A depressed body;

(2) A pair of the antennæ modified as fixing-organs;

(3) The mouth transformed into a sucking-tube; and

(4) Strongly developed foot-jaws.

IV. They differ likewise from the *Siphonostoma* in the following points :—

(1) The *first*, not the second, pair of antennæ are the fixing-organs;

* Vide Leydig, *loc. cit.* p. 39 &c.

(2) Palpi are wanting;
(3) A "sting" (gadd) is present in front of the mouth-tube;
(4) Two pairs of oral organs may be enclosed in this tube;
(5) The first pair of foot-jaws may have the form of sucking-cups.

V. The Argulidæ approach the *Branchiopoda in general* in
(1) The fundamental form of their extremities;
(2) The structure of the visual organs;
(3) The tendency to a shell-structure, expressed in the shape of the head-shield;
(4) The absence of palpi;
(5) The absence of external egg-sacs; and
(6) The absence of external spermatophores.

VI. To the *Phyllopoda* in particular they make an approach in
(1) The conspicuous segmentation of the trunk;
(2) The non-fusion of the symmetrical eyes into a single eye.

VII. To the *Cladocera* in particular they make an approach in
(1) The small number of the extremities; and
(2) The unsegmented tail.

VIII. They stand midway between the *Phyllopoda* and the *Cladocera* by virtue of
(1) Their mode of development.

IX. From both *Phyllopoda* and *Cladocera* they differ in the following points:—
(1) They are organized for a parasitic existence;
(2) The extremities are entirely without branchial appendages;
(3) The tail is transformed into a respiratory plate;
(4) The generative apparatus shows some peculiarities, particularly the presence of receptacula seminis;
(5) The eggs are ejected immediately after quitting the ovary;
(6) Parthenogenesis seems never to occur.

A glance over this sketch of the relations of the Argulidæ to the Copepoda on the one side, and to the Branchiopoda on the other, will, we think, lead to the conviction that the Argulidæ cannot possibly be referred to the first-mentioned order, but that, on the contrary, they approach the Branchiopoda through such important characters that their reception amongst these must be regarded as fully warrantable. In our estimation, the Argulidæ are *parasitic* Branchiopoda; and consequently we cannot share the view that they ought to constitute *a separate order*, in spite of the many points in which, as we have shown above, they differ from both Phyllopoda and Cladocera. Thus the characters which are both necessary and sufficient for de-

fining strictly the limits of the Branchiopoda among the other lower Crustaceans—the compound eyes with unfacetted cornea, the absence of palpi or branchial appendages on the oral organs, lobed or cloven respiratory or swimming-feet without median plates, distinct sexes—occur in the Argulidæ. The discrepancies which depend on their parasitic habits cannot be put forward as reasons for the isolated position of the Argulidæ, at least as long as parasitic and free Copepoda are unanimously referred to the same order. If we look at these differences, we find that between the Argulidæ on the one side, and the Phyllopoda and Cladocera on the other, no greater dissimilarities exist than those which separate these two groups from each other. Although indeed it must be admitted that the Argulidæ stand nearer to the Phyllopoda than to the Cladocera, it seems to us nevertheless that the differences we have mentioned (we would recall in particular the form and function of the tail, and the presence of receptacula seminis), in conjunction with the characters which are correlative to their parasitic nature, are sufficiently strong to set aside the notion of the introduction of the Argulidæ *among* the Phyllopoda. We regard them consequently as a group of the same systematic value as these and the Cladocera—that is to say, a *suborder*, on a par with these, in the order of the Branchiopoda,—and propose, since *Argulidæ* or *Argulina* are only suitable as family names, for this suborder the appellation *Branchiura*, drawn from the characteristic condition of the tail in these animals. Just as the Cladocera are composd of one family only (the Daphnidæ), the Branchiura for the present comprise only one family (the Argulidæ).

We think that the Branchiopoda (if we reserve the fossil Trilobites, which undoubtedly belong to them, and with whose oral organs and feet we are not sufficiently acquainted) may be characterized as follows:—

BRANCHIOPODA.

Oris partes palpis fere semper carentes, appendicibus branchialibus nullis; maxillarum par 1–0, maxillipedum 2–0. Oculi duo magni laterales, sæpe in unum coaliti, e multis bacillis crystallinis compositi, cornea supra æquali prædititi. Segmentorum et pedum numerus valde varians: pedes fissi vel foliacei, appendicibus branchialibus plerumque instructi, nulla lamina intermedia bini conjuncti. Corpus testa membranacea, plerumque bivalvi, sæpissime inclusum. Sexus distincti.

I. PHYLLOPODA.

Oculi compositi plus minus sejuncti. Pedum paria 10–60. Metamorphosis completa. Libere natantia.

1. Branchipodidæ. 2. Apodidæ. 3. Limnadidæ. 4. Nebalidæ.

II. CLADOCERA.

Oculi compositi in unum coaliti. Pedum paria 4–6. Metamorphosis nulla. Libere natantia.

1. Daphnidæ.

III. BRANCHIURA.

Oculi compositi sejuncti. Pedum paria 4. Metamorphosis incompleta. Parasitantia.

1. Argulidæ.

[To be continued.]

XXXVI.—*On a new Species of Beech-Marten from Formosa.* By Robert Swinhoe, H.B.M. Consul at Taiwan.

When I read my paper "On the Mammals of the Island of Formosa" before the Zoological Society (December 9, 1862), I I noted that I had not at that time been made aware of the existence of any species of *Mustela* in the island. Since then, from the mountains of the interior towards the south, I have procured, through my hunters, a fine species of forest-Marten, which is perhaps the handsomest animal that I have had the good fortune to obtain. Dr. J. E. Gray's invaluable epitome of the known species of the *Mustelidæ* (Proc. Zool. Soc. Jan. 24, 1865) has enabled me to determine, without much troublesome research, that the Formosan animal is an undescribed species. The Formosan Marten has, as might be expected, its nearest ally in *Martes flavigula* (Bodd.), of the Nepal Hills. I would propose to distinguish our species as the

Martes chrysospila.

Head blackish brown, the hairs on the occiput being tipped with white. Centre of inside of ear white. Chin, sides of head, throat, and central streak of underneck also white. Sides of neck a fine bright golden colour. Body, above and below, bright purplish brown, becoming nearly black on hind quarters, hind legs, and tail. Fore legs blackish brown, pale down their fronts. Claws whitish. Length, from muzzle to base of tail, 20½ inches; from base of tail to tip of hairs at its end, 17 inches. Top of shoulder to tip of fore foot about 8 inches.

Habitat. Mountain-forests of central Formosa.

Martes flavigula is thus briefly described by Dr. Gray, in the paper above referred to: "Yellowish; head, nape, rump, legs, and tail black; chin and lower parts white." I cannot remark on the difference of the cranium and dentition of the two species, as I have no specimen of the Nepalese species to compare with.

Amoy (China), June 22, 1866.

XXXVII.—*Note on the "Glass-Rope"* Hyalonema. By Dr. J. E. Gray, F.R.S., V.P.Z.S., F.L.S. &c.

In the 'Proceedings of the Zoological Society' for 1835, p. 63, I described and formed the genus *Hyalonema* for a specimen that had been sent from China to the India House in London, under the name of the *Glass Plant*. I afterwards procured a specimen from Leyden, and found that it was an inhabitant of the Japan seas, whence it had been procured by Dr. Siebold. Since the trade with Japan has been opened, many specimens of the coral have been received from the latter country, where they do not seem to be uncommon, and where at least they are collected, on account of their beauty, as objects of commerce.

In 1857, Prof. John Frederick Brandt, of St. Petersburg, described a coral that had been brought from Japan by M. Possiet, one of the officers of the Russian Expedition, which agrees with the Glass-Rope of Japan in many particulars, but has the polypes much more produced and crowded; therefore he formed it into a genus, which he described under the name of *Hyalochæta Possieti*, Bull. Scien. de l'Acad. d. Scienc. d. St. Pétersb. xvi. n. 5, Mélanges, Biolog. ii. 606.

Both these Japanese corals and a species of *Hyalonema* which he calls *Hyalonema affine* are described in detail and well figured in a special work on the subject, entitled "Joannes Fredericus Brandtii Symbolæ ad Polypos Hyalochætides spectantes, tabulis iv. illustratæ. Petropoli 1859," large folio.

My *Hyalonema Sieboldi*, of Japan, has been well figured and described by Professor Max Schultze in 'Die Hyalonemen, ein Beitrag zur Naturgeschichte der Spongien,' von Max Schultze, mit fünf zum Theil in Farbendruck ausgeführten Tafeln: Bonn, 1860, 4to.

These works leave very little more to be said on the structure of these corals.

Very recently a species of the genus has been discovered on the coast of Portugal, which has been described and figured in the 'Proceedings of the Zoological Society,' in two papers by Professor J. V. Barboza du Bocage, of Lisbon:—1. "Note sur la Découverte d'un Zoophyte de la Famille *Hyalochætides* sur la côte du Portugal" (P. Z. S. 1864, p. 265); 2. "Sur l'Habitat du *Hyalonema lusitanicum*" (P. Z. S. 1865, p. 662).

The Japanese species, according to the observations of Prof. Brandt, have only twenty tentacles, while Prof. Bocage describes the Portuguese species as having forty, and also as seeming to differ in its habits.

I may note that Dr. Leidy, who agrees with Valenciennes in thinking the bark of *Hyalonema* a parasite, says there is a sponge

in the Museum of the Academy of Sciences of Philadelphia which has a corona of twisted siliceous spicula, about 2 inches long, which mainly differ from those of *Hyalonema* in size (Proc. Acad. Nat. Sci. Philad. 1860, p. 85). It is said to have come from Santa Cruz. May this not be a young *Hyalonema* in the sponge? The two specimens of the genus *Hyalonema* which Dr. Leidy examined appear to have been without the sponges at the base; and as the genus is found on the coast of Portugal as well as Japan, there is no reason one may not be found at Santa Cruz.

Before proceeding to make some observations on the extraordinary theories that some zoologists, and some even of high repute, have entertained respecting this genus, I wish to correct an error into which I have fallen.

Misled by the dry and imperfect state of the bark of the specimen which I first described, and also perhaps by a preconceived opinion that then existed that a bark-coral must be an *Alcyonaria* with pinnate tentacles, in the Synopsis of the British Museum (1840), and in a paper, on the arrangement of Corals, in the 'Annals and Magazine of Natural History' for 1859, I arranged the genus with the Barked *Alcyonaria*, and formed an order for its reception, under the name of *Spongicolæ* or *Hyalophyta* (Ann. & Mag. Nat. Hist. ser. 3. iv. p. 441). Professor Brandt in his work has shown that they are Zoantharia allied to *Corticaria*, or Polyzoa having many simple conical tentacles in two rows; and Professor Bocage has also shown this to be the case in the species found on the coast of Portugal. The Japanese species have twenty, and the Portuguese forty tentacles.

Professor Schultze also figured the conical tentacles of the Japanese species, and shows that they are, like other Zoantharia, furnished with stinging darts (t. 5. f. 4 & 5). This latter author goes so far as to describe the animal as a species of *Polythoa*, under the name of *P. fatua*; but of this more hereafter.

I admit that I ought not to have made this mistake; for a closer inspection of the contracted cell of the polypes ought to have shown me that probably they had more than eight tentacles; and now my attention is called to the fact, I am astonished how it could have escaped my observation before.

The specimens which I first described from Japan had the thinner tapering lower end of the coral inserted in a sponge of the genus *Halichondra*, the lower end of the axis forming a pencil of spicula at the base of the sponge.

Professor Max Schultze figured three specimens similarly attached to a sponge, the outer surface of the sponge being in a much more perfect condition, showing the oscula, than in the one

I described (t. 1, & t. 2. f. 1 & 2)—all the sponges having a flat base, by which they were evidently attached to some marine body.

Professor Brandt also figured (t. 1. f. 4 & 5) a specimen which has the basal part surrounded by a slender oblong mass of sponge; but this sponge does not show any expanded base, and seems only like a parasitic sponge attached to the base of the coral, as sponges are often found on sea-weeds; and the figure shows a sponge of a much finer texture, so that it does not seem to be the same kind of sponge as that attached to my specimen or those described and figured by Professor Schultze.

Observing that the polypes on all sides of the cylindrical coral were equally developed, I came to the conclusion that the coral must have grown in an erect position, so that the animals could all have equal access to the sea and an equal opportunity of procuring their food.

Again, the specimens being sunk in a sponge that had a flat base by which it was attached to some marine body, I concluded that the natural habit of the animal was to develope itself in a sponge, so as to support itself in an erect position; and this idea was strengthened by finding that the sponge near the part where the coral perforated it was of a more condensed and harder texture than the other parts of it. I concluded that there was a kind of mutual understanding (such as we often find between animals that are parasitic on one another) between the sponge and the coral.

It was for that reason that I formed for the genus the order before referred to, which I called *Spongicolæ* or *Hyalophyta*. (See Ann. & Mag. Nat. Hist. 1859, iv. p. 439.)

It is true that the larger number of the specimens that are imported from Japan are without any appearance of a sponge at their more slender base; but I think it is very probable that the Japanese, who collect them as ornaments for sale, and who generally take off the larger part of the bark of the upper portion of the coral, may also carefully remove any sponge which they may think disfigures the specimen.

This habit of living sunk in a sponge does not seem to belong to all the species of the genus, and may not be universal, or even general among the species found in Japan; and that may explain why the specimens imported are generally destitute of any appearance of ever having been immersed in a sponge.

Professor Barboza du Bocage specially observes that the Portuguese species has never been found living in a sponge; his words are,—"La cohabitation ou l'existence simultanée sur le même axis de polypes et d'éponges, qu'on a remarquée sur quel-

ques spécimens du Japon, n'a pas lieu sur aucun des exemplaires du Portugal;" and he further observes that the thin basal portion of the axis which is inserted in the sponge in some of the Japanese specimens is covered with the polype-bearing bark, the polypes near the base being smaller. "Chez ces derniers (les exemplaires du Portugal) le *corium polypigerum* enveloppe l'axis d'une manière uniforme, il recouvre parfaitement l'une des extrémités de l'axis, la plus étroite, et de là il s'étend sans aucune interruption jusqu'aux $\frac{2}{3}$ ou les $\frac{3}{5}$ de la longueur totale. Les polypes placés sur l'extrémité de l'axis sont les plus petits de tous" (Proc. Zool. Soc. 1865, p. 663, & 1864, t. 22. f. 2).

These observations seem to have been carefully made; and they not only show that the living sunk in the sponge is not universal in the genus, but they completely dispose of the theory to which I shall have to refer, that what is called the axis of the coral is in fact an integral part of the sponge, in which the coral lives, and that what is called the bark is only a parasitic *Polythoa* that accidentally grows on the elongated spicula of the sponge.

It would be very interesting to know how the Portuguese species lives, and how it keeps itself erect in the sea, as in those species also the polypes seem to be equally developed on every side of the cylindrical coral; and this could not be the case if it did not live erect or nearly so. It cannot float like the cylindrical compound Medusæ, as the axis renders the coral too heavy for that purpose, and there is no inflated float to overcome the specific gravity of the coral.

It is to be hoped that Professor Bocage, who is still studying the subject, will be able to explain this part of the history of the animal.

The Japanese, who collect these "Glass Ropes" as ornaments, are in the habit of inserting a bunch of them in the holes made in the rock by the *Pholades*. A series of specimens so stuck into a *Pholas*-hole was exhibited by Mr. Huxley at the Linnean Society last year. Professor Brandt has figured a similar group (t. 2. f. 1). But it is quite a mistake to suppose that this is the way in which the "Glass Rope" lives in the sea. In the specimen which I examined, the cement could be seen by which they were attached to the holes; and the specimens in the same group varied from 2 inches to 16 inches in length, and they all had the bark pushed down so as to be near the surface of the hole. I saw one specimen placed in a hole, affixed with the thick end of the spicula and the broadest end of the rope downwards.

In 1857, MM. Milne-Edwards and Haime, in the first volume

of the 'Histoire Naturelle des Coralliaires, ou Polypes proprement' etc., observe, "Nous sommes portés à croire qu'il faudra ranger dans ce sous-ordre des Zoanthaires sclérodermes, à la suite des Antipathiens, un zoophyte très-remarquable des mers du Japon, qui se compose d'un cœnenchyme cortical, renfermant un faisceau de baguettes siliceuses très-grèles, tordu en spirale comme une corde dont les crins seraient faits avec du cristal. Le cœnenchyme est farci de petits spicules, et porte des tubercules déprimés dont le sommet est perforé et paraît être le calice du polype. Souvent l'axe fasciculé se dénude par sa base, et se trouve implanté dans une éponge; mais, d'après M. Gray, celle-ci y est étrangère. Je dois ajouter cependant que suivant M. Valenciennes ce singulier zoophyte appartiendrait à la famille des éponges" (p. 324). And in their Monograph of British Fossil Corals, p. lxxxi, they observe, "The genus *Hyalonema* established by Mr. Gray is also referred by some zoologists to the tribe *Gorgoniæ*; but the recent observations of M. Valenciennes tend to establish that the fasciculus of siliceous thread which constitutes the axis of this singular production belongs to the class of *Spongiæ*; and the polypes which we have observed in a dried state on different parts of the axis appear to be parasites belonging to the order *Zoantharia*."

In 1860 Professor Max Schultze published the elaborate essay above quoted; and he regards the rope of siliceous spicula as part of a sponge, and the polypes as parasitic on it, calling the polypes "*Polythoa fatua* mihi" (pp. 28 & 42).

Dr. Bowerbank, adopting the same view, in his lately published work on British Sponges, gives the following as the generic character of the genus *Hyalonema*:—"Skeleton an indefinite network of siliceous spicula, composed of separate elongated fasciculi, reposing on a continuous membrane, having the middle of the sponge perforated vertically by an extended spiral fasciculus of single elongated and very large spicula, forming an axial skeleton of a columnar cloacal system" (vol. ii. p. 9).

I must confess that I do not understand this description. If the fasciculus of fibres is "a cloacal system," how is it that the fibres have no connexion with the sponges, but are separated from the spiral fascicle by a hardened coat most closely attached to the elongated spicula? And if the rope is entirely covered with the zoophytes, as we have every reason to believe is the case, and as M. Brandt's figures show, what is the use of a "cloacal system" which has no exit? It has occurred to me, as Dr. Bowerbank does not take any notice of the polype-bearing bark that covers the axis, that he confounds the polypes with the oscula of the sponge, and, believing them to be oscula, thinks they are the exits from the cloacal system he describes.

The only pretence of a reason that Dr. Bowerbank gives for considering "the basal sponge" an "undoubted part of the animal" is, that "the sponge in the specimens that I described and the one attached to the specimen at Bristol are identical in structure,"—as if it were not to be expected that the sponge from Japan to which the various specimens of the Japan coral are attached would most probably be of the same species. (See vol. i. p. 196.)

On referring to the explanation of the plates in the first volume, I see my suspicions are verified. Dr. Bowerbank observes, "Figure 371, plate 35, represents a portion of the great cloacal column, exhibiting part of the spiral axial fasciculus surrounded by the remains of the dermal (!) coat with numerous *oscula* projecting from its surface. Copied from the 'Zoological Proceedings' for 1857" (vol. i. 197).

Unfortunately Dr. Bowerbank does not seem to have considered it necessary to examine the specimens, but simply copies the plate, or to examine other genera of corals; or he would have found that what he calls *oscula* are, as I called them in the description he quotes, polype-cells containing polypes having tentacles and all the internal organization, including a distinctly plicated stomach, exactly like the zoanthoid polype named *Polythoa* or *Corticaria*. Other naturalists, as Dr. Max Schultze, who have considered the axis as belonging to the sponge, have avoided this extraordinary error, and have regarded "the dermal coat with oscula" of Dr. Bowerbank as a parasitic *Polythoa*.

Dr. Bowerbank also observes, "There is a close approximate alliance to the forms of the cloacal appendages of *Hyalonema* in the corresponding organs of the British genus *Ciocalypta*, Bowerbank" (vol. i. p. 197). If this comparison is correct, possibly *Ciocalypta* is not a sponge; and the figure (vol. i. t. 30. f. 360 & 361) renders it doubtful. But all the descriptions of this work are so indistinct and crowded with technicalities peculiar to the author, that they are very difficult to understand, and render a new examination of the species and a new work on the subject requisite.

I am not aware that any reason has been assigned for the theory above referred to, unless the enigmatical description of the genus above quoted of Dr. Bowerbank can be considered one; and I can only suppose that it arose in M. Valenciennes's mind from the fact of the spicula being siliceous and in chemical composition like the spicula of the sponge to which some of the Japanese specimens are attached.

Professor Max Schultze enters into a long description of the spicula of the sponge, and figures several of them; but I cannot see what bearing that has on the subject; for he does not

show that any spicula of a true sponge are like the spicula that form the axis of the coral. They certainly have little affinity to the elongated siliceous spicula of the genus *Alcyonellum* or *Euplatella*, with which they have been compared.

The chemical part of the question I do not think of much importance: we know so little of the power of animals to secrete different substances. It is true that *Hyalonema* is the only Zoantharian yet discovered that secretes siliceous spicula; but if the marine and freshwater sponges secrete both calcareous and siliceous spicula, and a horny axis more or less hardened with calcareous matter, and the Alcyonaria and Zoantharia secrete a horny axis more or less hardened with calcareous matter and abundance of calcareous spicula, why should we say that these much more highly organized animals have not also the same power as the sponges to secrete from the sea-water silica, and therefore that a Zoantharia-polype that lives on a siliceous axis is a parasite, especially when we find that this Zoantharian polype has its bark and polype-cell strengthened by siliceous spicula, some of them exactly similar in form and structure to the spicula of the axis, which must have been secreted by the animal? And therefore it is, to my mind, most unphilosophical to believe that the spicula of the axis are formed by the sponge, and the similar spicula in the polypes formed by the animal which the advocates of this theory regard as a parasite having only an accidental connexion with the axis.

The discovery of a species of *Hyalonema* on the coast of Portugal has proved that there is a species of the genus (and a most distinct one) that secretes siliceous spicula exactly like the spicula of the Japan species, that has no sponge attached to it or forming part of its body; so that it cannot be the "cloacal system" of a sponge that does not exist.

Professor Max Schultze, who regards the bark and polype of the Japanese species as a parasite, describes it as a species of the genus *Polythoa*, under the name of *Polythoa fatua*; but it differs from all the species of the genus *Polythoa* that I have examined in having the parietes of the polype-cells strengthened with siliceous spicules which are exactly similar in structure and form to the spicula of the axis.

This peculiarity, which I should consider conclusive that the axis is formed by the same animal as the bark, is common to the Japanese and Portuguese species.

Professor Barboza du Bocage observes:—

"Le *corium polypigerum* et les polypes sont formés de plusieurs tissus en couches superposées, dans lesquels on trouve une quantité très-considérable de spicules siliceux, dont les caractères morphologiques varient pour chaque couche.

"L'aspect granuleux, chagriné, que présente la surface extérieure du *corium* et des polypes n'est pas le résultat d'une simple incrustation de détritus de sable (comme on l'affirme pour les individus du Japon), mais il est dû à la présence d'un nombre infini de spicules réguliers, en forme de massue et hérissés de pointes. Ces spicules font partie intégrante de la couche la plus extérieure ou tégumentaire.

"Chaque polype est soutenu par une charpente siliceuse de spicules filiformes, disposés longitudinalement et à intervalles égaux sur la paroi interne de la cavité du corps." (Proc. Zool. Soc. 1865, p. 663).

The thickness of the elongated spicula of the axis is commensurate with the size of the entire coral, they being thin in the short young specimens, and thicker in the longer and more developed specimens. As they increase in length, they gradually become thicker by the deposit of fresh layers of siliceous matter on the outer surface, which is, doubtless, deposited by the flesh of the bark that surrounds each of the fibres; and new spicules also appear to be developed as the coral becomes thickened, as there are intermixed between the thicker spicula thin ones of different degrees of thickness; but generally they are of the same length as the rest. This seems to show that they are developed by the animal that lives in the bark, and are not shot out from the sponge at the base. But I might go on giving reasons without end, showing that the theory of those that believe the animal is a parasite is at variance with all parts of the organization of the coral and the animal that forms it.

If we note the number of persons who have expressed an opinion on this subject, there is no doubt that the general opinion of zoologists, including some of high scientific reputation, as Valenciennes, Milne-Edwards, Max Schultze, Leidy, Bowerbank, and others, is against my view of the subject; but it is to be observed that I am supported by Professor Brandt and by Professor Barboza du Bocage, both of whom have paid great attention to the subject, and have given the reasons for their belief; while most of the others above quoted have only expressed an opinion, without giving the facts on which it is founded.

I may add that, after much calm consideration of the question, and with the utmost willingness to change my opinion, if I found any evidence to induce me to do so, I still believe that the bark and the axis are parts of the same coral, and made by the same animal. In a former paper I observed that "the idea (that the bark of the coral is a parasite) requires the belief in the existence of two peculiar bodies which are always found together and are unknown in any other state, instead of regard-

ing them as parts of the same animal" (Ann. & Mag. Nat. Hist. 1859, iv. 441). And the discovery of a second species in Japan, and a third on the coast of Portugal, in all of which the bark and axis are found together, I think entirely destroys any idea that there is the slightest reason for believing the theory propounded by Valenciennes, and which has been so readily adopted, I may almost say without re-examination, by other naturalists.

This theory has had the effect of confusing the nomenclature of the Japanese species, which I first described as under:—

I. *The coral consisting of the bark and axis.*

Hyalonema Sieboldii, Gray, P. Z. S. ii. 1835, p. 63; Brandt, Symbolæ, &c. t. 1. f. 1, 10.
Halinema, Ehrenb. Monatsb. Berlin, 1840, p. 2 & 3 (a misprint?).

II. *The bark only, without the axis or sponge.*

Polythoa fatua, Max Schultze, Hyalonemæ.

III. *The sponge without the rope-like axis or bark.*

Spongia octancyræ, Brandt, Symbolæ, 14, note; Ehrenberg, Monatsb. 1860, p. 170.
Spongia crucigera, Ehrenb. Monatsber.

IV. *The sponge and the elongated united axis without the bark and animal.*

Hyalonema Sieboldii, Max Schultze, Die Hyalonemen, 9.
Hyalonema mirabilis, Gray, Bowerbank, Brit. Spongiadæ, 49.
Hyalonema, Valenciennes, Milne-Edwards and Haime.

This coral, which was first regarded as a plant and then as a sponge, has been considered by one of the first microscopists an artificial production! Thus Professor Ehrenberg, in an elaborate paper in which he gives an abstract of the various essays that have been written on the *Hyalonema Sieboldii*, concludes thus:—

"Glass-corals must be considered an artificial production, not less than those Indian idols produced in the shells of mother-of-pearl. The long siliceous threads, widely distributed over the Pacific, are with much labour collected in small quantities, probably from an unknown large species of *Tethya*; they are formed into bundles, which are forced into or through the tubular leather-corals allied to *Polythoa*, so that the fine end of the bundle, which is first pushed through, remains simple, whilst the remainder obtains a spiral form through the rotatory mani-

pulations. It is also possible that the bundles of fibres with polypes attached are immersed into the sea, so that the leather-corals (which always cover other objects) continue their development, forming a larger or smaller covering. At all events, the siliceous axis appears to be foreign, and not living. It is an innocent fraud, which became a branch of industry, and which, like the transplanted spur on the head of a living cock, may be a source of silent pleasure to the sentimental speculating Japanese" (Monatsb. Berlin, 1860, pp. 181–182).

XXXVIII.—*On new British* Hydroida.

By the Rev. Thomas Hincks, B.A.

The species that are briefly characterized in the following paper will be more fully described and figured in the general history of the British Hydroid Zoophytes on which I am now engaged, and which I hope will soon be ready for the press.

Subkingdom *CŒLENTERATA.*

Class *HYDROZOA.*

Order **HYDROIDA.**

Suborder TUBULARIDA.

Family **Corynidæ.**

Genus Coryne.

C. vermicularis, n. sp.

Zoophyte forming dense shrubby tufts; *hydrocaulus* smooth, branched dichotomously, of a very light straw-colour and delicate texture, wavy, annulated, especially towards the base, the branches and upper portions of the stem often smooth or slightly wrinkled; *polypites* of great length (about $\frac{1}{6}$ inch when mature), stout, almost cylindrical for half their length, when extended, and then tapering off very gradually towards the oral extremity; tentacles in irregular and very distant whorls, rather stout, with large capitula, about twenty-five in number. *Reproductive sacs* borne at the base of the tentacles over the lower part of the body, spherical, shortly stalked.

Height of the tufts about $\frac{3}{4}$ inch.

Distinguished by the great size and worm-like appearance of its polypites and the sparing distribution of the tentacles over the body.

Hab. Shetland, from deep water.

Suborder CAMPANULARIDA.

Family **Campanularidæ.**

Genus Campanularia.

a. With free gonozooids, of the *Obelia* type.

C. flabellata, n. sp.

Syn. *Campanularia gelatinosa*, Van Beneden, 'Les Campanulaires,' 33, pl. 1 & 2.

Hydrocaulus filiform, somewhat zigzag, branched, strongly annulated above the origin of the branches, of a dark horn-colour; *branches* given off at each bend of the stem, alternate, flexuous, rather short and fan-shaped, divided and subdivided dichotomously, and ringed above each division, forked immediately above the point of origin, the arms of the fork tending in opposite directions, and giving a subverticillate appearance to the ramification. *Hydrothecæ* alternate, short and subtriangular, with a wide aperture and an entire margin, borne on ringed and tapering pedicels of variable length. *Gonothecæ* axillary, ovate, pedicellate, slightly flattened at the top, with a short tubular orifice. The gonozooids are probably, like those of *C. geniculata* and *dichotoma*, of the *Obelia* type.

This species seems to have passed as a variety of *C. dichotoma*. It is, however, separated from it by a group of distinctive characters—the subverticillate habit, the flabelliform branches, the flexuous stem, the short subtriangular calycle, and the much larger size. *C. flabellata* attains a height of 8 or 10 inches.

Hab. Tenby, on rocks in tide-pools (Alder); Scotland (Sir J. Dalyell).

* Gonozooids unknown.

C. gigantea, n. sp.

Stem delicate, of a very light horn-colour and papyraceous texture, annulated at the base and below the calycle, irregularly and sparingly branched; *branches* erect, copies of the primary shoot, sometimes themselves branched. *Hydrothecæ* of enormous size, deeply campanulate, very wide at the top and for some way below it, and then tapering off gradually; length about double the greatest width, the rim cut into numerous broad and blunt teeth. *Gonothecæ* unknown.

Height about an inch.

The calycles of this well-marked form are many times as large as those of any other British species.

Hab. Lamlash Bay, on shell (Prof. Wyville Thomson).

Genus Gonothyræa, Allman.

G. hyalina, n. sp.

Shoots densely clustered on the creeping stolon, tall and

much branched; *main stems* very slightly flexuous, of a deep horn-colour below, becoming white and very delicate towards the upper extremity, strongly annulated at the base and above each division, giving off branches at each bend; *branches* erect, flexuous, very tender and hyaline, sometimes of great length and much ramified, ringed above every calycle and ramule. *Hydrothecæ* alternate, much elongated, slender, of very thin texture, with nearly parallel sides for two-thirds of the length, and then tapering off to the base, borne on ringed pedicels, the rim cut into numerous shallow denticles of castellated form, slightly indented at the top. *Gonothecæ* axillary, irregularly ovate, flattened at the top, and supported on a ringed stalk.

Height about 2 inches.

I place this fine species provisionally in the genus *Gonothyræa*. From the structure of the capsule I infer that this is its true position; but I have not traced the history of its reproduction.

Hab. Profusely investing *Tubularia*, *Halecium*, &c., from Shetland. I am indebted to J. Gwyn Jeffreys, Esq., for my specimens.

Cuspidella, nov. gen.

Hydrothecæ cylindrical or subcylindrical, sessile on a delicate creeping stolon, with a conical operculum, composed of many pieces. Polypites cylindrical, with a single verticil of filiform tentacles. Reproduction unknown.

C. humilis, n. sp.

Hydrothecæ very minute, subcylindrical, the upper portion divided into ten or twelve convergent segments, which form an operculum. *Gonothecæ* unknown.

The calycles of this curious species are little cylinders, terminating in a point above, and rising directly and without any trace of a pedicle from the creeping stolon.

Hab. On the stems of zoophytes: North Wales, Yorkshire, Northumberland, Shetland, Connemara.

Suborder SERTULARIDA.

Family Sertularidæ.

Genus Sertularia.

S. attenuata, n. sp.

Syn. *Sertularia rosacea*, Ellis, Corall. 9, pl. 4. fig. C; Johnston, Brit. Zooph. 470. (Specimen from Orkney, Lieut. Thomas.)
Sertularia pinaster, var., Johnston, Brit. Zooph. 72, figs. *c*, *d*.

Hydrocaulus straight, somewhat rigid, pinnately branched, often running out above into long tendril-like filaments, thickened

and bifid at the extremity; *branches* simple, or bearing one or two ramules, alternate, inclined upwards, sometimes furnished with tendrils. *Hydrothecæ* opposite, tubular, slender and gracefully curved, about half their length free and divergent, but not abruptly bent, with a plain suberect aperture. *Gonothecæ* (female) elongate-pyriform, tapering off below and expanding gradually upwards, bristling with strong spines above, arranged on six longitudinal ridges and extending down the upper third of the capsule; (male) ovate, with six longitudinal ridges, terminating above in angular points, the aperture central and subconical.

Allied to *S. rosacea,* with which and *S. pinaster* it has been confounded. It is more robust and rigid and of larger growth than the former of these species, and wants its delicate membranaceous texture. The reproductive capsules of the two are totally dissimilar.

Hab. On other zoophytes: North Devon, Cornwall, Brighton, Yorkshire coast, Peterhead (C. W. Peach).

I have also to record the occurrence of the following species on our coasts:—

Clava leptostyla, Agassiz.

On a mussel-shell from Morecambe Bay; obtained by Mr. F. H. West, of Leeds.

Gonothyræa gracilis, Sars.

Birterbuy Bay, Connemara; dredged by G. S. Brady, Esq.

XXXIX.—*On Glyptodon and its Allies.* By Hermann Burmeister.

From a recent French publication I learn that you have published in your valuable Journal a translation of my observations on the species of *Glyptodon* in the public museum of Buenos Ayres, which I published here in the 'Pharmaceutical Review' for 1863. That paper was written in the beginning of the year 1863, when I had in my possession only the entire skeleton referred to and a very few portions of the two other species, at that time the only ones known to me. Now, after the lapse of three years, I am acquainted with *eight* species found in this country; and I therefore send you these *further remarks* on the specific differences, in order to complete and correct my first publication.

I begin my further notices of the skeleton by correcting an error into which I have fallen in saying that the second bone of the neck, which M. Serres has now named "os mesocervicale,"

is composed of *five* anchylosed vertebræ. It consists only of *four*, namely the second to the fifth; and the sixth is free; but the seventh is united with the first and second dorsal vertebræ to form a large piece, which Professor Huxley has named the trivertebrated bone, and M. Serres the "os metacervicale." This piece has always the same general construction in the four different species of which well-preserved examples are now before me; but the mesocervical bone is not always composed of four vertebræ, but in some cases of *five*. The sixth vertebra is then united with the four preceding ones, in the same way as these with each other, and the animal has no free vertebra between the *meso-* and *metacervical* bones.

Out of the four specimens of necks which I have seen belonging to the same number of distinct species of *Glyptodon*, only one is constructed in this way, of five united vertebræ; the other three have only four vertebræ anchylosed.

As we have other portions of the skeletons of these same individuals with scales of the carapace, I can affirm with certainty that these three species with four anchylosed vertebræ have a short conical tail with large rings of conical tubercles, exactly of the form described by me in the species which I have named *G. spinicaudus*. As this is the case, I have decided to abandon my first name, as indicating not a specific, but probably a generic character, and to supply another name of more specific signification. Among the species described by other authors, I find in the work of M. Nodot on *Glyptodon* (which was unknown to me when I wrote my observations) that this author has formed those with short conical tails of tuberculated rings into his genus *Schistopleurum*; that his first species, *S. typus*, which is very fully described, is the same that I had named in our museum *G. elongatus*, on account of the narrow and elongated form of the carapace, and especially of the pelvis; that the second species, *S. gemmatum*, Nod., which has the surface of the carapace much smoother, was therefore named by myself *G. lævis*; and that the third species, described by me as *G. spinicaudus*, is unknown to Nodot, unless it be his *G. subelevatus* (p. 94, pl. 11. fig. 1). As this species is smaller, and has the carapace of a more spherical form and the surface of the scales very rough, I now propose to name it *G. asper*.

Nodot's *S. tuberculatum* is not a *Schistopleurum*, but a true *Glyptodon*; for I suppose the tip of the tail figured in the 'Ostéographie,' pl. 1. fig. 5, and copied by Nodot, pl. 8. figs. 7 & 8, to belong to this species. We have in the museum here such a tail as is figured in the 'Ostéographie,' pl. 1. fig. 4 (copied by Nodot, pl. 8. fig. 6), and I am much inclined to affirm that this and the other are of the same species, the construction of our

tail being somewhat intermediate between the two French figures.

The mesocervical bone of four united vertebræ was figured and briefly described as containing from the second to the fifth vertebra, by Lund in the Transactions of the Academy of Copenhagen, where the author names the animal to which this bone belonged *Hoplophorus euphractus*. The genus *Schistopleurum* must therefore be named *Hoplophorus*, the two genera being perfectly identical, and Dr. Lund's name the older one. His other figures of the same animal prove its identity with *Schistopleurum* as completely as that of the mesocervical bone.

As regards the fourth mesocervical bone, with five united vertebræ, I do not know exactly the species to which it belongs; but from the general construction of the bone I am inclined to think that it may belong to *Glyptodon clavipes*, Owen. We have of this species a carapace not so well preserved as that figured by Owen, a well-preserved pelvis, and some other bones. Some months ago I communicated to Professor Owen figures of this pelvis and of the pelvis of *Schistopleurum gemmatum*, then named by me *Glyptodon lævis*, as also of my *G. spinicaudus*, now to be named *Hoplophorus asper*, in order to show him the great differences in the construction of the pelvis in these three species. The pelvis of *G. clavipes* is the strongest—the branch of the os pubis, which forms the superior boundary of the foramen obturatorium, especially being much thicker than in the other two species, in which it is as thin as a pencil and much longer, and the foramen obturatorium is much larger. As all these characters of the pelvis in *G. clavipes* indicate a stronger and more solid construction of the skeleton, I think we are justified in believing that the construction of the neck in this species was also stronger than in the others.

The same character of strength, but still more strongly marked, is presented by a pelvis of which I have only one side before me. This pelvis is more than one-half larger than that of *G. clavipes*, has the same strong pubic branch, and a much narrower foramen obturatorium. From the construction of the bone, as well as from the general size of the animal, I conclude that the pelvis belongs to a very large species, of which we have in the Museum the complete tip of the tail. This was described by me in my first memoir as belonging to *G. tuberculatus*, Owen; but having since seen this author's figures copied in Nodot's work (pl. 9), I find that this was a mistake, and that this tail is identical with that figured by Nodot, pl. 8. figs. 3–5, copied from the 'Ostéographie.' Nodot has described, but not named, the species as belonging to two different kinds (pp. 102 & 103). He also gives (p. 100) a short description of two scales, figured (pl. 12. figs. 6 & 7) as *G.*

verrucosus; and these scales belong, in my opinion, to the same animal, to which therefore this name may be applied.

The pelvis in question, which I regard as belonging to this *G. verrucosus,* is well figured in Robin's 'Journal d'Anatomie et de Physiologie' for March 1866, pl. 2, where M. Pouchet describes it as belonging to a new species, *G. giganteus,* founded by M. Serres in a paper which I do not know. This well-executed figure gives a good idea of the strength of the pelvis and the great size of the animal. As the very well-preserved tip of the tail in our public Museum is 2 feet 8 inches long and 7 inches in diam. at its commencement, we may calculate that the animal was 10–12 feet in length, if not more, and that its body was an enormous mass, like a large oval rock. Nevertheless this species was not the largest of the family—the tail of *G. tuberculatus,* figured in the 'Ostéographie,' pl. 1. fig. 4, and preserved in our Museum, being of double the size, comparing its general figure with that of the former. From the precise similarity in the position of the elliptical and radially striated figures on the two tails, I was at first inclined to believe that both belonged to the same species; but as I have now seen three other specimens of both tails of the same form, I must regard them as belonging to different species. To understand their difference in general size, it is sufficient to compare the smallest lateral elliptical figure, like a rosette, on the tails of the three species. In *G. clavipes* this rosette measures $2\frac{1}{4}$ inches, in *G. verrucosus* $4\frac{1}{2}$ inches, and in *G. tuberculatus* $5\frac{2}{3}$ inches. If this difference be truly indicative of the general size, as I believe to be the case, the last-mentioned species was one-fifth larger than that named *G. giganteus* by M. Serres.

With regard to the general form of the tail, I will only repeat what I have already said in my first communication—namely, that the tail of every true *Glyptodon* had rings, probably six in number, before the large cylindrical apex which alone was previously known. This apex contains in its interior ten small vertebræ; and beyond the sacral vertebræ the skeletons have always three or four free vertebræ covered by the hinder part of the carapace. On comparing the size of the bodies of these vertebræ with the first of the apex of the tail, it is evident that there was between them a series of from six to eight vertebræ which were covered by the free rings of the tail. In this way I calculate the total number of the caudal vertebræ of *G. clavipes* at 20–23.

As I am engaged upon extended descriptions of the species in the Museum, to be published in the second part of the 'Anales del Museo publico de Buenos Aires,' which will soon be sent to press, I will not here enter upon any further details, but conclude this communication with a short revision of the species in question.

I. Glyptodon.

Tail elongated, conical, the rings before the apex formed of flat shields or scales, the apex more or less cylindrical, with a bulbous swelling at its commencement. Mesocervical bone with five united vertebræ.

A. Scales or shields of the carapace with uniform warty sculpture, only the marginal row of the carapace before the marginal tubercles with an elliptical rosette.

1. *G. tuberculatus*, Owen, Nodot.

2. *G. verrucosus*, Nodot (*G. tuberculatus*, nob., in former communication).

B. Scales or shields of the carapace with a central subhexagonal rosette, and six smaller subpentagonal ones on the circumference; the scales of the margin of the carapace before the marginal tubercles with a very large central rosette, occupying nearly the whole shield.

3 & 4. *G. clavipes* auctorum.

Note.—We have in the Museum two different kinds of tails,—the one shorter, broader, and flatter, with an elliptical transverse section; the other longer, thinner, and higher, with a more circular section. I believe they belong to two different species; but as I do not know the exact form of the tail of Professor Owen's *G. clavipes*, I must leave it doubtful which of my species is the true *clavipes*.

II. Hoplophorus, Lund.

Schistopleurum, Nodot.

Tail short, conical, with six rings of large conical tubercles on the end of each ring of the upper side of the tail*. Mesocervical bone consisting of four united vertebræ, the sixth free. Scales of the carapace with one hexagonal figure in the centre, and six pentagonal ones on the circumference.

5. *H. elongatus*, nob. (*Schistopleurum typus*, Nodot).

6. *H. gemmatus*, nob. (*S. gemmatum*, Nodot).

7. *H. asper*, nob. (*G. spinicaudus*, nob. *anteà*).

8. *H. pumilio*, nob., Anales del Museo publico de Buenos Aires, i. p. 77. Of this last species I know only the lower jaw, but, from its general figure, I suppose the species to belong to this section.

* As we have in the Museum a well-preserved tail of the species which has been described by Nodot as *S. typus*, with moveable central tubercles on the rings, I can affirm that this construction is not natural, but caused by the imperfect healing of the broken tubercles during the life of the animal. This process is denominated in surgery *artificial articulation*.

Note.—To the description of *H. asper* (= *G. spinicaudus*) I will add that the number of ribs in this species is thirteen pairs, not fourteen, and that the first two pairs of ribs are united to the large excavated manubrium sterni. This is followed by a smaller piece, to which two pairs of ribs are also attached, and which is united with the manubrium by a synchondrosis. Then follow two small sternal vertebræ, to which three pairs of ribs are attached; and then comes the processus xiphoideus. Thus there are seven pairs of true, and six pairs of false ribs.

XL.—*Additional Remarks on the Homologies of the Flowers of Conifers.* By Andrew Murray, F.L.S.

On looking over my paper on the above subject in last month's 'Annals,' I see that I have scarcely sufficiently unbosomed myself on one point, which, on reperusal, seems to me to deserve more remark than I gave it.

The point is, whether the bract is the equivalent of the petal or of the calyx. That it is part of the floral envelope I have no doubt; and all that I said regarding it in that capacity (which was the most important point of view in my inquiry) would apply equally to it as either.

The main purpose to which I put it was to prove that the scale was equivalent to the disk, as lying between the pericarp and the petal or floral envelope; and on that point I do not think more need be said. But the question remains,—What particular part of the floral envelope is represented by the bract?

In my last paper I pointed out that the appearance of the scale of the female flower of *Wellingtonia gigantea* might lead to the belief that it was the equivalent of the male scale, and consequently must be the female petal; and I warned the reader against adopting that view, because I considered that the more petaloid character of the bract (a claret-coloured crust in *Wellingtonia*) rendered it improbable that it should be the calyx, and the green scale the petal. Having arrived at this conclusion, I omitted to give, or, rather, I deleted from my paper, an explanation which had occurred to me of the mode in which the scale combined the functions of disk and petal.

On reconsideration, that explanation appears still to have so much to recommend it that I now briefly submit it to the reader as an alternative view of the homology of the bract.

We have seen that the petal of the male flower is merely a continuation of the leaf-scales growing on the twig which bears the flower. That the scale of the female flower seems to be in

exactly the same relation to the leaf-scales on its twig is a strong argument in favour of that scale being a petal too.

If it really be so, then, of course, the bract must be the calyx. Its texture (wholly or partially petaloid) is suggestive of no character so much as that of part of the floral envelope.

There is nothing inconsistent with this being the case in the bract appearing before the scale: the calyx always precedes the corolla in development. But it would be inconsistent with the process of development were the scale, if it be a petal, to continue increasing in size *pari passu* with the seed, as it in fact appears to do; but the explanation of this growth may be, that it is the disk which grows at the base of the petal. I pointed out that the growth of the scale was not equal all over, but took place chiefly towards the base; the apophysis, in short, may be the outer coat of the petal resting like a mantle on the top of the disk which has grown up under it, in the same way that the hip of a rose increases in size, bearing up upon its crown the decayed rose-petals, only that in the Conifers the substance has penetrated between the outer and inner walls of the petal, and filled out the space between them. And if we refer back to the structure of the scale, as shown in Plate X., we shall see that there is nothing in it inconsistent with this notion. The scale is composed of two layers, as it were, with an indication of an intermediate line running backwards between them from the prickle in the midst of the apophysis—in other words, from the supposed point of the petal. And if we examine a rose-hip, we find it is composed of two layers also, with an intermediate one wedged in near the apex, on which the petals and stamens grew. In the Conifers the inner layer has a double woody core, like a set of branches separated into blades. The rose-hip has a similar set of ligneous fibres branching through its inner layer or disk; and what is noteworthy is, that these too are disposed in double layers or blades.

The scale and bract of *Cunninghamia Sinensis* and *Sciadopitys verticillata* come nearer to the hip of the rose than those of any other Conifer which at present occurs to me. In these the bract is united to the scale; so that we have the calyx, petal, and disk all united, as in the rose, the petal being represented by a woolly fringe on the crown of the scale.

Thus, as we have in some Conifers the bract united to the scale, and in others not, it is plain that the union of these different parts is not essential to the relations of a disk, as indeed we know from other facts; and accordingly in the yew we have the other extreme, in which the calyx, petal, and disk are all separate and distinct.

The yew also shows us that although in cone-bearing Conifers

the flower is monopetalous, theoretically it is dipetalous, the half of it only being present in them; for when, as in the yew, we have the whole present, we then find a petal or scale on each side, opposed to each other at the base of the disk, which only begins to grow after the petals or scales have attained their full dimensions.

It may be that I am wrong in referring the claret-coloured crust of petaloid texture which I observed between the scales in *Wellingtonia* to the bract, and that it has not this relation at all, and also that cypresses have truly no bract. Should that be so, it would furnish a good distinctive character for separating the cypresses from the pines.

I owe some apology to the reader for desiring to give additional explanation on an opinion expressed so recently; but in all new lines of thought the mind is at first apt to veer backwards and forwards as new objections or doubts suggest themselves; and although it may not be better for the scientific reputation of the thinker, it is certainly better for the progress of truth, that these vibrations should be candidly acknowledged, so that the real weight of the objections may be estimated by fresh and impartial minds.

XLI.—*Notulæ Lichenologicæ.* No. X.

By the Rev. W. A. Leighton, B.A., F.L.S.

CLADONIÆ ACHARIANÆ.

The Rev. l'Abbé Eugène Coëmans, of Gand, Belgium, has recently published, in the 'Bulletins de l'Académie royale de Belgique,' sér. 2. t. xix., the results of an investigation of the herbarium of Acharius, so far as regards the *Cladoniæ*. The herbarium of Acharius is preserved in the Museum of the University of Helsingfors; and its arrangement is precisely that of the latest work of this author, the 'Synopsis methodica Lichenum,' 1814. The collection comprises 43 genera and about 980 species, besides innumerable varieties. The localities whence the specimens have been gathered are generally noted; but the specimens themselves are often small, and with respect to those communicated by others we have no other clue to whence they came than the peculiar handwritings of the correspondents of the illustrious lichenographer. The *Cladoniæ* constitute about a fifteenth part of the collection, and, although not the most beautiful portion, is nevertheless exceedingly precious, and contains a great number of the types of Flörke, Schærer, and Léon Dufour.

The object proposed in this revision of the Acharian herba-

rium (and also of those of Délise, in the Museum of Paris, and of Flörke, at Rostock, the results of which will form separate papers) is to fix the synonymy of the species and the diverse varieties of these authors, to simplify the nomenclature by the suppression of a great number of useless varieties, and to indicate some new ideas on a certain number of the species, —thus constituting a prodromus for a new monograph of the genus *Cladonia*.

1. *Cladonia papillaria,* Hffm., (Ach.) Syn. p. 248 et hb. ejusd.

This species, although poorly represented in the Acharian herbarium, is found there in all states of development, except with perfect apothecia. The localities indicated, as for most of the other species, are France, Germany, and Sweden.

2. *Cladonia retipora,* (Ach.) Syn. p. 248.

No specimen. Acharius knew it only from the description and figure of Labillardière.

3. *Cladonia cæspititia,* (Ach.) Syn. p. 249 et hb. ejusd.

The specimens are very insignificant. A specimen from Lapland merits notice by reason of the high latitude of its habitat.

Most modern lichenographers consider *C. cæspititia* to be a distinct species, whilst others regard it as a variety of *C. squamsoa.* Frequent study and observation of this plant in the woods of Héverlé, near Louvain, and in the pine-forests of Meirelbeke, near Gand, convince me that it is only a variety of *Cladonia pyxidata, pityrea.* On some oaks in the wood of Héverlé, now unfortunately felled, I have for many years observed all the transitions between *C. fimbriata* (Ach.) and *C. pityrea* (Ach.), and between this latter and *C. cæspititia.* I believe, therefore, we must henceforth regard *C. cæspititia* as a variety of *C. pyxidata* (L.).

4. *Cladonia strepsilis,* (Ach.) Syn. p. 249 et hb. ejusd.

This Acharian species has always been problematical. Dr. Nylander, who had examined the Acharian herbarium, refers it to *C. cæspititia* (Lich. Scand. p. 57, and Syn. p. 211); on the contrary, Flörke, who had also examined the Acharian specimens, recognizes it only as a sterile and macrophylline form of *C. cariosa* (Comm. p. 14). In reality, both these learned lichenologists have foundation for their opinions. The principal specimen of *C. strepsilis* of Acharius (alone preserved entire, for the others have been mutilated) is positively the *C. cæspititia*; but the variety *plumosa* (Ach. Syn. p. 250) is a sterile form of

C. cariosa. Dr. Nylander refers it to *C. delicata,* Flk. (Nyl. Syn. p. 211).

In the herbarium of Flörke, preserved in the museum of Rostock, there are a great number of specimens of *C. cariosa* with sterile and macrophylline thalli, perfectly similar to the *C. strepsilis* b. *plumosa* of the Acharian herbarium. He has therefore confounded two neighbouring forms, but belonging to two different types.

The *C. strepsilis* (Ach.) represents only an insignificant form of *C. cæspititia,* and may therefore be neglected in lichenography. As to the variety *plumosa,* it may be mentioned as a sterile form of *C. cariosa,* without elevating it to the rank of a variety.

5. *Cladonia alcicornis,* (Ach.) Syn. p. 250 et hb. ejusd.

Under this name many different species are preserved in the Acharian herbarium:—

(1.) Divers specimens of the true *C. alcicornis,* collected in France, Germany, and Switzerland. There is no specimen from Sweden, notwithstanding that this species grows in the Scandinavian peninsula, even to the 60th degree of latitude. I have found it abundantly this summer, especially on the west side of Sweden.

(2.) Two specimens of *C. cervicornis* received from Germany. This error of determination is very easily explained by the difficulty which very often exists of distinguishing with certainty the thallus of *C. cervicornis* from certain sterile forms of *C. alcicornis* which have the inferior surface of their leaflets rose-coloured or purplish.

(3.) Eight tufts of *C. pungens,* Flk. This error seems almost inexplicable; but the examination of the herbarium of the celebrated Swedish lichenographer has proved to me that, to the end of his life, he never rightly knew the *C. pungens,* and that the reproach which Flörke formerly addressed to him, that he did not know the *Cladoniæ* well, was sometimes not without foundation.

Lastly, amongst the specimens of *C. alcicornis* in fructification there is a specimen of *C. degenerans,* and another of *C. pyxidata,* fertile. Could it be through carelessness that Acharius placed here these lichens?

The *C. gentilis,* (Ach.) L. U. p. 530, which Acharius at first made a variety of *C. alcicornis,* but which he withdrew in his 'Synopsis,' in consequence of the criticisms of Flörke, most certainly belongs to *C. alcicornis.* It constitutes, according to the two small specimens in the herbarium at Helsingfors, a form or even a variety with simple narrow leaflets having long black fibrillæ on their margins. The aspect of this variety reminds us of that of *Physcia leucomela,* Mich.

6. *Cladonia endiviæfolia,* Fr. (Ach.) Syn. p. 250 et hb. ejusd.

Two specimens of this species deserve to be cited here—one from the isle of Aland, the most northern station known, and the other from Tiflis, by the late Stevens, whose rich herbarium is also in the museum of Helsingfors. The Acharian herbarium comprises also some specimens from France, received from M. Léon Dufour, and bearing this inscription: "Affinis *Cen. convolutæ,* ast semper subtus cervino." Acharius has ticketed these thus: "var. major *Cen. endiviæfoliæ.*" They are perfectly referable to the var. *firma* of *C. alcicornis* (Nyl. Syn. p. 191).

There is also a pretended variety of *C. endiviæfolia* or of *C. alcicornis,* concerning which we have no certain information—the variety *cladomorpha.* In his first works Acharius regarded this as a variety of *C. alcicornis*; afterwards, in his 'Synopsis' (p. 259), he attaches it to *C. degenerans*; and lastly, in the Supplement to that work (p. 342), he joins it to *C. endiviæfolia.*

The Acharian herbarium demonstrates undoubtedly that this variety is only a form of *C. degenerans,* var. *lepidota.* For the future, therefore, this variety must be suppressed. As to the *C. alcicornis, cladomorpha* (Ach.), Rabenhorst, 'Cladoniæ Europææ,' tab. i. no. 5, it scarcely differs from the type of this species.

The *C. endiviæfolia* itself is not a good species, but forms only a variety of *C. alcicornis,* as I have shown in my 'Cladoniæ Belgicæ,' No. 7 (1863).

7. *Cladonia cervicornis,* Schær., (Ach.) Syn. p. 251 et hb. ejusd.

This lichen is badly represented in the Acharian collection.

The var. *prodiga,* Ach. L. U. pp. 531–532, is, according to the fragments still in the Acharian herbarium, only a small, insignificant proliferous form of the type.

8. *Cladonia verticillata,* Flk., (Ach.) Syn. p. 251 et hb. ejusd.

This species, or, more correctly, this perfect form of the preceding type, has, in the herbarium at Helsingfors, representative specimens from the principal countries of Europe, and even from North America.

Flörke did not separate the *C. cervicornis* from *C. verticillata,* and that justly. Acharius himself did not always know how to distinguish these two forms from each other, as is proved by certain hesitating determinations in his herbarium and the confusion of the two types in this collection.

I regard, therefore, the *C. verticillata* as the type of the species, and the *C. cervicornis* as a simple macrophylline variety.

9. *Cladonia pyxidata* (L.), (Ach.) Syn. p. 252 et hb. ejusd.

Acharius, in his Synopsis, distinguishes four forms and one variety of *C. pyxidata,* all of which are found in his herbarium.

And first as to the forms. He designates under the name *simplex,* spermogoniferous non-proliferous individuals; under that of *staphylea,* apotheciferous individuals; under that of *syntheta,* proliferous plants; and, lastly, under that of *lophyra,* squamiferous specimens. These distinctions appear to me very useless, and only serve to overload the nomenclature with new names, and in effect only indicate that each species has a spermogoniferous, fertile, proliferous, or squamulose state. These Acharian forms may therefore well be rejected.

With regard to the form *lophyra,* Acharius has applied this name to two distinct forms, at first to *C. pyxidata* (Syn. p. 253), and afterwards to *C. fimbriata* (Syn. Suppl. p. 342). The typical Acharian specimen belongs nevertheless to *C. pyxidata.*

Amongst the *C. pyxidata* of the Acharian collection are found many different species,—a Swedish specimen of *C. cariosa*; another of *C. cornucopioides* from Switzerland; a third of *C. pityrea* (Ach.), received from France; and, lastly, a specimen of *C. decorticata,* Fr., collected in Norway. We must not infer, however, from this inexactitude, that Acharius confounded all these species. It merely shows that in reviewing his herbarium, towards the close of his life, he did not always give the requisite attention to the work.

As to the var. *β. coralloidea* (Syn. p. 253), it is very difficult to decide with certainty to what species it belongs, because the specimens, or rather fragments in the Acharian herbarium are particularly small and altogether insufficient. These specimens are of the height and have nearly the aspect of *C. papillaria molariformis,* and have short, abortive, granulose, and spermogoniferous branches. Acharius had only once met with a small tuft of this variety*. No one since his time has rediscovered it; moreover it is only an accidental form of *C. degenerans* or *crispata,* and consequently may be neglected. The only developed specimen which permits us to distinguish any characters exhibits the summits of the branches perforated, as in this last species.

The *C. coralloidea* (Ach.), Rabenhorst, Clad. Europ. t. xi., has no resemblance to the plant of which we are speaking, and is in fact *C. decorticata,* Fr., Nyl.

Acharius has not mentioned in his works a very important variety of *C. pyxidata,* named by Flörke var. *chlorophæa*; so

* The two small fragments from Switzerland, which equally bear the name of *C. coralloidea* in the Acharian herbarium, do not belong to the same type.

that I was very curious to ascertain to what species he had referred it in his herbarium—to *C. pyxidata* or to *C. fimbriata.* I found that he had not distinguished this variety, and that he had placed it sometimes under one, and sometimes under the other of these Acharian species.

All lichenographers know of the controversy which existed so long between Flörke and Acharius on *C. pyxidata* (L.). I have examined the herbaria of these two masters, and I am bound to say that, although Flörke in general knew the *Cladoniæ* better than his rival, nevertheless he was wrong on this question.

10. *Cladonia pocillum,* (Ach.) Syn. p. 253 et hb. ejusd.

It is long since lichenographers considered *C. pocillum* as a distinct species, they having more recently made it a variety of *C. pyxidata* (L.). I find nevertheless that this form does not differ sufficiently from the type to enumerate it as a variety, especially in so polymorphous a group as the genus *Cladonia.*

When a station is examined where *C. pyxidata* grows in abundance, we see that all the young individuals approach more or less to *C. pocillum,* and that intermediate forms passing into *pyxidata* are much more common than the two types. Acharius himself had often a difficulty in distinguishing these two forms; and more than one specimen in his herbarium bears at the same time the two names *C. pyxidata* and *C. pocillum.* I would therefore recommend the var. *pocillum* to be erased from our floras.

11. *Cladonia pityrea,* (Ach.) Syn. p. 254 et hb. ejusd.

The Acharian types, although not numerous, are nevertheless good and very characteristic; but his two varieties *acuminata* and *decorticata* differ very little from each other, and represent the same type. The former has the thallus subuliform, granular, simple, or branched; the latter is a little more decorticated, whiter, and sometimes bears squamose leaflets. This latter approaches sufficiently near to *C. decorticata* of Flörke to be regarded as synonymous. The plants of Flörke have, however, all the characters so well defined that I can easily conceive how this author was tempted to make of it a distinct species.

The variety *acuminata,* Ach., is not sufficiently distinct from the type of the species to deserve mention in our floras, as may be seen in my 'Cladoniæ Belgicæ,' Nos. 93 & 94. The form *decorticata,* on the contrary (not that, however, which is found in the Acharian collection, but that which is represented in the herbarium of Flörke), deserves to be cited. It may be easily confounded with *C. macilenta* in a sterile condition, or, in the squamulose forms, with *C. squamosa frondosa* of Délise.

Flörke (Com. p. 81. obs. 2) accuses Acharius with having described, under the name of *Cen. pityrea acuminata,* only a form of *Clad. furcata;* but the Acharian herbarium shows that this reproach is unmerited.

The *C. pityrea* (Ach.), which, in my opinion, is nothing but a variety of *C. pyxidata,* gives rise to a great number of forms, which are found nearly alike in all the countries of Europe. These forms are, for the most part, wanting in the Acharian herbarium. I have found therein only the form *Isignyi scabrida,* Dél., mixed with the var. *acuminata,* Ach., or designated by M. Léon Dufour under the name of *Cen. delicata.*

Some specimens of *C. squamosa* from Switzerland are marked in the Acharian herbarium, *Cen. pityrea*?

12. *Cladonia fimbriata,* (Ach.) Syn. p. 254 et hb. ejusd.

All botanists know how polymorphous this species or, rather, this var. of *C. pyxidata* is. Thus Acharius, in distinguishing the different modifications, established eight subvarieties or forms of the type, and two varieties more remarkable. Nevertheless this author did not know many important forms of this *Cladonia,* e. g. *C. glauca,* Flk., *ochrochlora,* Flk., *pyxidata fruticulosa,* Flk., *pyxidata fastigiata,* Flk., and *pyxidata pterygota,* Flk.

As to the two Acharian varieties, they are so little remarkable, that they may be, without any inconvenience, referred to the type. The var. *conista,* especially, with its two subvarieties *exilis* and *macra,* is in reality altogether insignificant. The var. *carneo-pallida* is distinguished only by its pale or rose-coloured apothecia—a peculiarity which is observable in many species of this genus, *e. g.* in *C. gracilis, furcata, furcata* var. *pungens, squamosa,* and *degenerans,* and which is frequently only the result of a kind of etiolation. Moreover Acharius has confounded with this variety the *C. carneola,* Fr.

As to the forms of the type, they may be reduced to two—the form *tubæformis,* comprehending the subvarieties *carpophora* and *prolifera* of Acharius, and the form *cornuto-radiata,* comprising the subvarieties *radiata, abortiva, fibula, cornuta,* and *nemoxyna* of the same author.

In species so polymorphous as the present one, it is incumbent on us to avoid the creation of varieties with too narrow limits, since otherwise the characters are applicable only to a certain number of selected forms, whilst science is embarrassed and our herbaria encumbered with the host of remaining intermediate forms. Thus, although Flörke has established more than twenty varieties or forms of *C. pyxidata,* I have found in

his herbarium at Rostock hundreds of specimens which he was unable to refer to any one of his types.

Some faulty determinations here also disfigure the Acharian herbarium: thus we find in it an entire series of *C. deformis,* from Sweden, under the name of *C. fimbriata*; and *C. macilenta,* from Switzerland, under that of *C. fimbriata fibula*; the typical *C. pyxidata* and its variety *chlorophæa* are intermingled with *fimbriata*; and some specimens of *C. cenotea* bear at the same time, though with a mark of doubt, the two names of *cenotea* and of *fimbriata.*

13. *Cladonia gonorega,* (Ach.) Syn. p. 258 et hb. ejusd.

When I examined, in the Acharian herbarium, and still more in that of Flörke, the long series of specimens intended to justify the varieties created by these authors, I could not refrain from asking what advantage science could possibly derive from such numerous and subtle distinctions. They rather serve to embarrass than facilitate lichenology, and are by no means sufficient to denote all the forms of a species so variable as *C. degenerans.* Moreover the herbarium at Helsingfors contains, under the name of *formæ variantes,* more than forty specimens of this species which Acharius was unable to compress into his classification.

In my opinion, the forms *aplotea, euphorea, anomæa, pleolepis, lepidota, cladomorpha, polyphæa, scabrosa, virgata,* and *gracilescens* do not deserve to be distinguished as particular forms; and this is also the opinion of Acharius himself (Syn. p. 258), "vix sub nominibus singularibus denotari merentur."

The form *trachyna* is more remarkable, and especially more easily recognizable; it may therefore be retained by uniting with it the forms *lepidota, pleolepis,* and *virgata.*

As to the variety *nivea,* Ach. (Syn. p. 260), it belongs to *C. pungens,* Flk.; and Acharius, on revising his herbarium, after his Synopsis was printed, unites it with that species.

Notwithstanding these diminutions, *C. degenerans* will still reckon a certain number of varieties; for the forms *hypophylla, pleolepidea,* and *basima,* recently described by Dr. W. Nylander (Lich. Scand. p. 54), appear to me sufficiently remarkable to be elevated to the rank of varieties. I have this summer found all these forms in great abundance on the borders of the Baltic Sea, both in Sweden and Russia.

The Acharian herbarium here also contains many erroneous determinations: thus, under the name of *gonorega* appear a specimen of *C. turgida,* from Sweden, two of *C. pyxidata,* in a proliferous state, from Switzerland, and a tuft of *C. furcata crispatella,* Flk., from Sweden. Two forms of *C. glauca,* Flk.,

from Central France, and one of *C. cenotea*, from the Pyrenees, are marked, by the hand of Acharius, *Cen. gonorega virgata*, and *Cen. gonorega vetusta*. *C. squamosa* is also intermingled with the forms *scabrosa* and *gracilescens*. Lastly, three specimens, branched and tortuous, of *C. furcata* are ticketed *Cenomyce gonorega*? var. *palmacea*; and a small specimen of *C. amaurocrea* from Switzerland is also marked *Cen. gonorega*. It is very difficult to understand how the learned lichenographer could possibly have united all these species with *C. degenerans*.

14. *Cladonia peltasta*, (Ach.) Syn. p. 261 et hb. ejusd.

The Acharian herbarium contains only one specimen of this rare species, gathered in the Isle of Bourbon and received from Bridel. The specimen has been partially removed, but sufficient still remains to recognize the characters of the species.

Acharius has erred in placing this Lichen amongst the scyphiferous lichens: its proper position is near to *C. rangiferina*.

15. *Cladonia ecmocyna*, (Ach.) Syn. p. 261 et hb. ejusd.

This species is now more generally known as *Cladonia gracilis*.

As in other species, so here also, many of the Acharian varieties are of too little importance to be retained: e. g. *amaura*, *floripara*, *leucochlora*, *valida*, *elongata*, and *exoncera*.

The var. *corymbosa*, Ach. (Syn. p. 263), does not belong to *C. gracilis*, but to *C. furcata*, as Dr. Nylander has already remarked, and as the Acharian herbarium confirms.

Making the var. *hybrida* (Ach.) the type of the species, four forms or principal varieties may be distinguished, viz.:—

The form *chordalis* (*gracilis*, Ach.) for plants which are slender, subuliform, or with narrow scyphi.

The form *macroceras*, to characterize those robust and gigantic forms which attain, in arctic or alpine localities, to 25 centims. in length.

The form *aspera*, to designate folioliferous specimens with crisped, lacerated scyphi, and which remind us, by their general appearance, of the var. *trachyna* of *C. degenerans*.

Lastly, the form *cornuta*, to indicate those forms which have the upper portions of the stems subpulverulent, and which have heretofore constituted a separate species under the name of *Cladonia cornuta*, Fr.

The incorrect determinations observable in the Acharian herbarium are as follows:—

1. Under the name of *C. ecmocyna* α. *gracilis* are found some specimens of *C. furcata*, var. *surrecta*, Flk. (from France), and three others of *C. pyxidata cornuta* (from Switzerland).

2. A robust specimen of *C. furcata* (from Switzerland) and another of *C. amaurocræa* appear amongst the *C. ecmocyna* γ. *macroceras* e. *exoncera*.

3. A *C. crispata* (from Sweden) and a fragment of *C. amaurocræa* (from France) are labelled as *C. ecmocyna* δ. *corymbosa*.

4. Amongst the *C. ecmocyna* ε. *aspera* we meet with a *C. furcata* (fertile), which Acharius has marked subsequently *Cen. alcicornis*?

16. *Cladonia oxyceras*, (Ach.) Syn. p. 262 et hb. ejusd.

Acharius has confounded here, in his Synopsis, two species, or at least two very distinct forms, *C. uncialis* (L.) and *C. amaurocræa*. At a later period he recognized this error, and in the herbarium has consequently indicated in pencil all the specimens referable to *C. uncialis*. Bearing in mind these corrections, the *C. oxyceras* of the Acharian herbarium may be regarded as synonymous with *C. amaurocræa* of Flörke.

To regulate the synonymy, the specimens of the different varieties of the Synopsis are here referred to their proper species, viz.:—

Var. *cladonioides* (Syn. p. 264) is referable to typical *C. amaurocræa* in a sterile state.

Var. *cetraroides* (Syn. p. 264) is the same species in fructification.

Var. *dicræa* (Syn. p. 265) is synonymous with typical *C. uncialis* (L.).

Var. *obtusata* (Syn. p. 265) is a very robust form of *C. uncialis* (L.) with swollen extremities.

Var. *medusina* (Syn. p. 265) constitutes a proper species—*Cladonia medusina* (Bory). The small specimen of the Acharian herbarium has been removed.

Var. *spiculata* (Syn. p. 265). The specimen of this in the Acharian collection has also been abstracted; it is therefore impossible, in the absence of other information, to indicate the species to which this variety may belong.

Besides these specimens, I have moreover found in the collection at Helsingfors a remarkable specimen of *C. amaurocræa*, sent from the Grimsel by the late M. Schærer, having nearly the appearance of *Cladonia portentosa* (Duf.), and named by Acharius *Cen. oxyceras crassipedia*, and another of the same species, with short stems swollen at the summits, called *turgescens* by the Swedish lichenographer.

17. *Cladonia sulphurina*, (Ach.) Syn. p. 265.

I have not found this species either in the Acharian herbarium or in that of Flörke; but I refer it to *C. deformis*, Hffm.,

after Dr. Nylander, who has seen the authentic specimens of Michaux.

18. *Cladonia baccilaris,* (Ach.) Syn. p. 266 et hb. ejusd.

The name *Cladonia macilenta* is now most generally used for this species.

Amongst the Acharian varieties, the first three (*styracella, carcata,* and *monocarpa*) ought, in my opinion, to be neglected, as approaching too closely to the type.

The var. *clavata* presents a modification more remarkable, and may be retained.

The var. *coronata* is, according to the Acharian specimens, synonymous with *C. polydactyla,* Flk., as also another variety, designated in his herbarium under the name of *Cen. baccilaris radiatæformis.*

I have not discovered amongst the *Cladonia macilenta* of the herbarium at Helsingfors any specimen which is referable to *C. Flörkeana.* Acharius therefore never knew this latter plant.

Dr. Nylander has already remarked the resemblance between *C. macilenta* and *digitata*; and I am myself inclined to unite these two species, and to regard *C. macilenta* as only a variety analogous to *C. pyxidata cornuta* and *fibula.* The Ardennes, in Belgium, has, during the past year, furnished me with beautiful transitional forms between these two types.

19. *Cladonia digitata* (L.), (Ach.) Syn. p. 267 et hb. ejusd.

Of the five forms or varieties of this species mentioned in the Synopsis of Acharius, good examples are found in his herbarium, but they only prove that nowhere is the distinction of varieties less necessary than here. I therefore propose to erase the forms *brachytes, denticulata, cerucha, cephalotes,* and *monstrosa.*

A specimen of *C. deformis* (from Sweden) is found intermixed with *C. digitata* in the Acharian herbarium. This collection, however, does not possess the intermediate forms passing into *C. macilenta*; but I have found them in the herbarium of the Museum of Finland, in the herbarium of Flörke, and in great quantity on the rocks of the Ardennes.

20. *Cladonia deformis* (L.), (Ach.) Syn. p. 268 et hb. ejusd.

We may here also suppress the varieties *crenulata, gonecha,* and *pulvinata,* proposed by Acharius.

21. *Cladonia coccifera,* (Ach.) Syn. p. 269 et hb. ejusd.

Acharius is here more moderate in making varieties than his rival Flörke; and for this he is deserving of praise. The only two varieties which he makes do not, however, deserve to be

maintained, inasmuch as they depend solely on slight modifications in the mode of prolification.

The herbarium at Helsingfors contains many folioliferous specimens of this species, and amongst them I observed a specimen of *C. degenerans.*

22. *Cladonia pleurota,* (Ach.) Syn. p. 270 et hb. ejusd.

This species is nothing more than a variety of the preceding. All the Achariau specimens are referable to *C. coccifera*; and Flörke (Com. p. 91) has wrongly reproached him for having confounded *C. pleurota* with *C. deformis.*

23. *Cladonia bellidiflora,* (Ach.) Syn. p. 270 et hb. ejusd.

The *C. bellidiflora* is the least polymorphous species of the genus, and preserves sufficiently well in its diverse modifications the typical characters of the species. Nevertheless Acharius has mentioned four varieties; but I must confess that his herbarium exhibits very little real difference between his forms *ampullifera, ventricosa,* and *gracilenta,* and that his var. *polycephala* appears to me to be only the type in fructification. For simplicity's sake, therefore, it is necessary to reject these artificial distinctions.

Some specimens of *C. bellidiflora* v. *polycephala,* sent from Grimsel by Schærer, seem to me to be rather *C. degenerans.*

24. *Cladonia ceratophylla,* (Ach.) Syn. p. 271 et hb. ejusd.

The Acharian herbarium contains only a well-characterized fragment of this species.

25. *Cladonia cenotea,* (Ach.) Syn. p. 271 et hb. ejusd.

The typical Acharian specimens present nothing remarkable. As to the var. *crassota,* it differs so little from the type, that it may be erased.

26. *Cladonia parecha,* (Ach.) Syn. p. 272 et hb. ejusd.

This Acharian species is synonymous with *Cladonia turgida,* Hffm.

The Acharian specimens are not numerous, but sufficiently pure, except a specimen of *C. uncialis obtusata* (Ach.).

The *Lichen candelabrum* of Bory de Saint Vincent, cited here as a synonym, differs considerably from *C. turgida,* and constitutes a distinct species—*Cladonia candelabrum* (Bor.).

27. *Cladonia crispata,* (Ach.) Syn. p. 272 et hb. ejusd.

All the specimens of the Acharian herbarium are perfectly typical, and exhibit no approach to any other species.

My learned friend Dr. Nylander regards *C. crispata* as a probable hybrid of *C. furcata* and *gracilis*. Is it not, rather, an intermediate product of *C. furcata* and *squamosa*? The herbarium of Flörke at Rostock possesses many mixed forms between these two species.

28. *Cladonia sparassa*, (Ach.) Syn. p. 273 et hb. ejusd.

This species is more generally known under the name of *Cladonia squamosa*, Hffm.

The Acharian herbarium contains only the most common forms of this species, which probably explains why Acharius, who was fond of multiplying forms, is here so sparing of his varieties.

Amongst his specimens are two beautiful specimens of *C. decorticata*, Fr.

29. *Cladonia cariosa*, (Ach.) Syn. p. 273 et hb. ejusd.

This species is represented in the Acharian herbarium by a dozen specimens, from different localities, and all perfectly typical.

There is a young and undeveloped form of *C. cariosa*, which is ordinarily given in Exsiccata under the name of *C. cariosa*, var. *symphycarpa* (Ach.). This is not found in this place in the Acharian collection, because he regarded it as belonging to the following species.

Some authors still unite *C. cariosa* with *C. pyxidata*. I am, however, fully convinced that it forms a good and excellent species.

30. *Cladonia symphycarpa*, (Ach.) Syn. p. 274 et hb. ejusd.

Under this name I found in the Acharian herbarium—

(1) Some young examples of *C. cariosa* from Sweden. This is the form which Schærer, Desmazières, Rabenhorst, Hepp, and Massalongo have published under the name of *C. cariosa*, var. *symphycarpa* (Ach.). It does not differ sufficiently from the type to constitute a variety.

(2) A fructiferous specimen, with small imbricated leaflets, of *C. alcicornis*, var. *firma*, Nyl., from Switzerland.

(3) A small specimen of the same plant, gathered in ancient Lusatia (environs of Gorlitz), and altogether similar to No. 13 of my 'Cladoniæ Belgicæ.'

(4) Some fragments of a short condensate form of *C. macilenta* from North America.

(5) Lastly, a specimen of *C. turgida*, reduced to a dense and microphylline thallus, as in my 'Cladoniæ Belgicæ,' No. 19.

Amidst this diversity, it is naturally very difficult to say what

this author intended by his *Clad. symphycarpa.* Nevertheless, as the young specimens of *C. cariosa* of which I have first above spoken were gathered in Sweden, and are the most ancient in the herbarium, it is reasonable enough to consider them the primitive types of Acharius. That which also confirms me in this opinion is, that the types of *C. symphycarpa* in the herbarium of Flörke, which have been compared with those of Acharius in the herbarium of Willdenow at Berlin, are precisely this small form of *C. cariosa.* Neither had Flörke a clear idea of the typical *symphycarpa,* for he has intermingled his specimens with many different species, as I shall have to remark in my forthcoming work on the *Cladoniæ* existing in the herbarium of this author.

I therefore regard the *C. symphycarpa* (Ach.) as only an insignificant form of *Cladonia cariosa.*

31. *Cladonia delicata,* (Ach.) Syn. p. 274 et hb. ejusd.

This plant is, in the Acharian herbarium, placed under *Stereocaulon.* Until 1824, Acharius had considered it a *Cladonia,* but in arranging his herbarium, after the publication of the Synopsis, he placed it under *Stereocaulon,* by inscribing on the old ticket *Stereocaulon delicatum.*

This species is, in the estimation of most modern lichenologists, only a variety of *C. squamosa*; and I participated in this opinion until, during this summer, I had the opportunity of studying it better in the herbarium of Flörke, at Rostock. I have never seen so many or such beautiful specimens. I then remarked the affinities of *C. delicata* to *C. pityrea,* and I am now convinced that the former is nothing more than a variety of the latter. In the monograph of the genus *Cladonia* which I am preparing I shall propose as a variety of *C. pyxidata* the *C. pityrea* with its two subvarieties *delicata* and *cæspititia.*

32. *Cladonia botrytes* (Hag.), Ach. Syn. p. 274 et hb. ejusd.

This beautiful little species, so common in Sweden and in Finland on decaying fir-stumps, is very richly represented in the Acharian herbarium.

33. *Cladonia leptophylla,* (Ach.) Syn. p. 274 et hb. ejusd.

The herbarium of Helsingfors contains only two specimens of this variety of *Cladonia cariosa*—one from England, the other from Switzerland. The leaflets of their thalli are very small and very dispersed.

34. *Cladonia capitata* (Mich.), (Ach.) Syn. p. 275.

This species is neither found in the herbarium of Acharius

nor in that of Flörke. I am therefore unable to supply any information concerning this problematical plant.

35. *Cladonia acicularis*, (Ach.) Syn. p. 275 et hb. ejusd.

This plant was generally regarded as belonging to *C. macilenta*; but now there is no doubt that it ought to be referred to the genus *Pilophorus*, and form the *P. acicularis* of Th. M. Fries.

36. *Cladonia aggregata*, (Ach.) Syn. p. 275 et hb. ejusd.

The *Cladonia aggregata* of Acharius and that of Flörke are, according to the herbaria of these authors, two entirely different plants. That of Acharius is the true *C. aggregata*, Eschw. Brasil. p. 278, and that of Flörke the *C. gorgonea* of the same author, Brasil. p. 271.

The collection at Helsingfors contains only a miserable specimen of this species; another specimen has been abstracted.

37. *Cladonia racemosa*, (Ach.) Syn. p. 275 et hb. ejusd.

Under this name is found, in the Acharian herbarium, the large and robust form of *C. furcata* known under the name of the var. *racemosa*, and also a specimen of *C. pungens nivea*, Flk., from Guadeloupe.

38. *Cladonia furcata*, Hffm., (Ach.) Syn. p. 276 et hb. ejusd.

The Acharian specimens represent the ordinary type. The var. *subulata* is not distinguished in his herbarium, but is found intermixed with other specimens. Many tufts of *C. furcata* bear here also, some with a sign of doubt, some with that of affirmation, the name of *C. alcicornis*, which proves that Acharius entertained doubts, even to the end of his life, as to the true characters of this species.

39. *Cladonia uncialis*, Hffm., (Ach.) Syn. p. 276 et hb. ejusd.

Here is found the true *C. uncialis*, which Acharius had confounded before with *C. amaurocræa*. The var. *adunca* is scarcely different from the type, and may therefore be erased.

It must be remembered that the varieties *dicræa* and *obtusata* of *C. oxyceras* (Ach.) are referable to this species.

40. *Cladonia rangiferina*, Hffm., (Ach.) Syn. p. 277 et hb. ejusd.

The first two varieties of Acharius, *gigantea* and *cymosa*, may be suppressed; for both represent the type—the first as the sterile form, the second as the fertile or spermogoniferous form. The largest specimen of the form *gigantea* in the Acharian herbarium measures 12 or 13 centimetres in length.

The var. *β. sylvatica* is a good variety, or perhaps even a distinct species; but the var. *alpestris* must not be separated from it. This form is by no means alpine, but merely that of most individuals which grow isolated instead of in crowded tufts.

The var. *δ. pungens,* marked in the Acharian herbarium *rangicornis,* belongs to *C. furcata*; and it is astonishing that Acharius did not recognize its affinity to this latter species.

As to the var. *pumila,* it is nothing more than a small form of *C. rangiferina sylvatica.*

Besides these varieties described in the Synopsis, I have found also in the Acharian herbarium an old specimen of *C. rangiferina sylvatica,* deformed and glomeruliferous, marked by Schærer *C. rangiferina,* var. *deformis,* and a form of *C. rangiferina* with short erect branches widened and united at the summit, ticketed by Acharius var. *incrassata.* I have frequently met with this form in the fir-woods of Sweden and Finland; but it is not sufficiently notable to be distinguished from the type. Acharius has confounded, in his herbarium, some of *Cladonia pungens,* Flk., with this latter form.

Lastly, the herbarium at Helsingfors contains also a beautiful tuft of *C. portentosa* (Duf.), which Acharius must have received after the publication of his Synopsis, for otherwise he would not have failed to notice this remarkable form.

41. *Cenomyce? vermicularis,* (Ach.) Syn. p. 278 et hb. ejusd.

The Acharian specimens were obtained from Lapland, Siberia, Germany, and Switzerland.

The var. *taurica,* in my opinion, does not deserve to be preserved distinct, since it is merely a swollen form of the type.

Acharius has proved his sagacity by placing this plant doubtfully among the *Cladoniæ*; it constitutes at the present day the type of the genus *Thamnolia,* of the tribe *Siphulei,* Nyl.

42. *Cenomyce? ceratites,* (Ach.) Syn. p. 279 et hb. ejusd.

The Acharian specimen was gathered in Lapland.

This species, which Acharius has wisely placed provisionally among the *Cladoniæ,* is the sole European representative of the genus *Siphula,* Fr.

Lastly, on the last sheet of the Cladoniaceæ of the Acharian herbarium, we see pellmell many specimens of *C. degenerans* and of *C. pungens,* Flk., which the learned lichenographer probably did not know what to make of, and which bear, with a sign of doubt, the names of *C. rangiferina,* var. *incrassata, C. crispata, C. gonorega,* and *C. ecmocyna,* var. *exoncera.*

XLII.—*On a new Species of* Halmaturus *from East Australia.* By FREDERICK M'COY, Professor of Natural Science in the Melbourne University, and Director of the National Museum of Victoria.

Halmaturus Wilcoxi (M'Coy).

Male. Fur long and soft, grey at the base (everywhere except on the breast, where the base is whitish), of a rich dark brown slightly grizzled with grey and black on the back (from some hairs grey at base having a white ring beyond the middle, and black tip), more uniform and slightly lighter on the shoulders, back and sides of the neck, and becoming lighter still on the cheeks, sides of the muzzle, and arms; the anterior feet, chin, a band from the nostril to the eye, and the mid line of the head darker brown; the apical two-thirds of the ears and the nape of the neck very dark rich brown; basal third of the ears, and a rounded space in front of the base of them, and a spot over each eye of a very bright rusty chestnut, chestnut, or bay; a very faint greyish band on hinder half of upper lip. The brown of the back becomes more rusty on the flanks, changing to the same bright rusty reddish brown as the base of the ears on the back of the hind legs, and also, though not so bright, where the brown of the flanks joins the greyish white of the belly, front margin of hind legs, underside of base of tail, and throat nearly up to the chin; upper side of tail dark brown, grizzled with black and white hairs like those of the back, but lighter in general tint at the base, darker towards the end, and whitish at the tip; underpart and sides of tail scaly and very sparingly set with short fur-hairs.

Female. Smaller and slightly paler than the male, and the whitish fur of the breast as grey at the base as that of other parts of the body.

	Male.	Female.
Length from tip of nose to tip of tail	3 feet 4 inches	3 feet $2\frac{1}{2}$ inches
,, of tail	15 ,,	14 ,,
,, of tarsus and middle toe, including nail	6 ,,	$5\frac{3}{4}$,,
,, of forearm and hand, including the nail	7 ,,	$5\frac{1}{2}$,,
,, from tip of snout to base of ear	$4\frac{1}{2}$,,	4 ,,
,, of ear from anterior basal ridge	$2\frac{3}{8}$,,	$2\frac{1}{8}$,,

Locality: Richmond River, New South Wales. Collected by Mr. Wilcox, who forwarded a male and female to the Museum at Melbourne, as probably new.

This beautiful species most nearly resembles the *H. parma*,

H. Thetidis, and *H. Derbianus,* but is easily distinguished from them by the bright rusty red brown of the basal third of the ears, the space about their base, the spot over the eye, and the back of the hind legs, as well as by the greyish brown colour of the neck and fore limbs. The proportional measurements are also different.

XLIII.—*Notes on the Pronghorn Buck* (Antilocapra), *and its Position in the System.* By Dr. John Edward Gray, F.R.S., V.P.Z.S., &c.

In the 'Proceedings of the Zoological Society' for 1855, when describing a pair of horns in the collection of the late Earl of Derby, I mentioned that the horn of the *Prongbuck* was "formed of agglutinated hair, that it was lined internally with a close velvet-like coat of short hairs, which were directed towards the top of the cavity, and that the edge of the base of the horn was furnished with a ring of hair." I observed that the "peculiarity in the internal structure of the horns of the genus showed, like the branched external form, a similarity to the horns of the deer, the hairy horns being the analogue of the deciduous velvet of the deer and the permanent hairy coat [on the horns] of the giraffe."

1. The peculiarity in the structure of the horn which isolates the Cabrit or Prongbuck from the other hollow-horned Ruminants seems to have been overlooked by the American naturalists; and the spoils of the animal are very rare in European museums.

The hunters of America stated that the Prongbuck shed its horns; but the systematic zoologists, who depended on the examination of the preserved skin and head for their facts, did not believe the assertion; and, indeed, some went so far as to deny the fact.

When the hunters at Fort Union said that the prong-horned Antelope dropped its horns, Messrs. Audubon and Bachman (Quad. North America, p. 198) considered it a sufficient reply to show them that "the bony part of the horn and the hard spongy membrane beneath were well attached to the skull and perfectly immoveable." They evidently had the deciduous horn of the deer in their mind, and could not conceive any other manner of shedding the horns, not foreseeing that the horny sheath might drop off the cores, which, if they had examined the structure of the horn and observed its internal fur, they might have anticipated as probable.

Cassin, in the 'United States Exploring Expedition' (p. 63), under *Antilocapra americana*, remarks, "Dr. Pickering, in his

note under 24th August 1841, observes, 'Dr. Marsh assures me that the horns of this animal are shed annually, like those of the deer.'"

Dr. Colbert A. Canfield, who resides in California, sent an account of the habits of the Prongbuck, in which he states as a fact that "the horns drop off annually," to Dr. Spencer Baird, of the Smithsonian Institution; but his paper (which is dated Sept. 10, 1858) was not published until after Mr. Bartlett had recorded his observation of the same fact, observed on the animal in the Zoological Society's Gardens.

Dr. Colbert Canfield's paper is printed in the 'Proceedings of the Zoological Society,' 1866, p. 105, and contains many very interesting particulars on the habits and manners of the animal.

Dr. Canfield truly observes that the horns of sheep and goats always have rings showing the growth of the horns, and that such rings are not to be observed on the horns of the Prongbuck.

When Dr. Canfield says that "the horns drop off annually," and observes to Dr. Spencer Baird, "To convince you of this singular fact is my principal object in making you this communication," he only intended to say that the horny sheath of the horns fell. The American hunters and Dr. Marsh must have intended the same, though Dr. Bachman and M. Audubon were deceived by the vagueness of the hunters' words; and even Dr. Marsh, when he added "like the deer," could only have intended to say that the case of the horns falls annually, and not that the entire horn or antler falls, as is the case with the deer.

Mr. Bartlett, in the 'Proceedings of the Zoological Society' for 1865, p. 718, gave a very interesting and detailed account of the manner in which the horny case of the horn separates from the core, and how the new horny case is formed between the inner surface of the old case and the core.

Mr. Bartlett in this paper endeavours "to prove that the Prongbuck's affinities are closer to the genus *Cervus*," to which he thinks "it is more nearly allied than to the Antelopes." Indeed he thinks he is "able to show that the horns of the Prongbuck are a modification of the horns of *Cervus*."

In this view I think that Mr. Bartlett is entirely mistaken, and that this theory obscures the otherwise very interesting details which he gives of the peculiarities of this animal.

2. In the hollow-horned Ruminants the bony processes of the frontal bone, which form the true horns of this group of animals, are permanent, and are covered, in the oxen, sheep, goat, and antelopes, with a horny case, which is increased in size as the core enlarges by the addition of new laminæ of horny matter to

the inner surface, especially near the edge of the sheath. The giraffes, on the other hand, have the same permanent cores, which are covered with a hairy skin, like the rest of the body, which covers the horn during the entire life of the animal.

The horns of the deer, with which Mr. Bartlett compares those of the Prongbuck, on the other hand, are only developed at a certain season of each year; and while they are being expanded, they are covered with a soft velvety skin containing a number of large blood-vessels: these vessels become obliterated and the skin falls off when the horns are fully developed; and at the end of the season the horns themselves fall off, leaving only a burr on the frontal bones.

Now in the Prongbuck the core of the horn is permanent, vascular, and exactly like the core of the horns of the true hollow-horned Ruminants, very unlike the deciduous horn of the deer, and showing the true affinity of the genus to the antelope and goat, with which it has been usually associated. It indeed only differs from the normal structure of that of the animals of this group in the core being covered with a case formed of agglutinated hair, which falls off annually, and is replaced by another case formed between its cavity and the outer surface of the core. The surface of the core is covered with a vascular skin, which secretes this deciduous coat of agglutinated hair, like the vascular coat that secretes and gradually enlarges and thickens the horny permanent case of the horns of oxen, sheep, and goats.

It is to be observed that the horny case of the core of all these animals is formed of agglutinated hair; but the hairs of the horns of the oxen, sheep, &c. are more closely agglutinated and regularly placed, forming a denser substance than the porous horny case of the Prongbuck, in which the several hairs of which it is composed are to be seen by the naked eye, and some of them projecting beyond its surface.

I think that the above observation proves that the Prongbuck is more nearly allied to the typical hollow-horned Ruminants, with which it has been placed, than with the deciduous-horned deer, with which Mr. Bartlett proposes to unite it. Indeed it only differs from them in the outer case of the horn being porous and formed of loosely agglutinated or, rather, felted hairs, and in the case being deciduous and renewed annually, instead of being permanent and strengthened by internal laminæ so as to form a hard horn.

There is no doubt that this peculiarity of the structure and derivation of the sheath, or rather case, of the horns affords a very good character to separate the Prongbuck from the other hollow-horned Ruminants; and I suggest that it should be formed into a family, which should be called **Antilocapridæ**, of equal

rank with Bovidæ and Giraffidæ, between which families it ought to be placed.

The Ruminants may be divided, according to their horns, thus:—

I. The males and generally the females furnished with a bony process on each frontal bone, which is permanent during the lives of the animals.

In the Bovidæ this bony process is covered with a permanent horny coat.

The horn (*coleocera*) has the same appearance, form, structure, and is enlarged in the same manner as the hoofs over the toes.

In the Antilocapridæ the bony process is covered with a porous horny coat, which falls off and is renewed annually.

The horn or pseudo-horn (*komecera*) of the Cabrit is *sui generis*. It seems to be formed of the matted or felted hair of the skin that covers the core. It loosens and falls off in the mass when the new coat of matted hair is formed beneath it. The horns may be compared to the annual coat of matted hair which is shed by the American bison and some other ruminants; but in that animal the hair only forms a kind of blanket, and falls off in flakes of different sizes.

In the Giraffidæ the bony process is covered with a skin like the rest of the body, and equally permanent, and the horn (*dermocera*) covered with hair that is shed and renewed like the hair of the body.

II. The males and sometimes the females are periodically furnished with horns, which, during development or expansion, are covered with a vascular skin coated with down, the skin falling off when the horns are perfect and solidified, and the horns themselves falling off at the end of the season. In some few the horns spring from the end of a permanent elongated bony process, as in the Muntjac. (Cervidæ.)

The antlers (*epochocera*) of the deer differ from the horns of the other ruminants in being periodical developments of bone, which is at first covered with a hairy skin, that dries up and falls off.

III. Neither sex provided with any horn-like process of the frontal bone, as the musk (Moschidæ), camels, llama (Camelidæ).

XLIV.—*On the Classification of* Buprestidæ *and* Elateridæ, *with special regard to the Danish Fauna.* By Prof. J. C. Schiödte.

[Continued from p. 212.]

Systematic Table of the Danish Buprestidæ and Elateridæ.

BUPRESTIDÆ.

(Tarsi quinquearticulati. Antennæ filiformes. Corpus durum. Coxæ anticæ globosæ. Coxæ posticæ transversæ, fixæ. Prosternum processu postico producto.)

Epimera mesothoracica inter episterna et humeros elytrorum ad epimera prothoracis ascendentia et cum iis articulata.

Prosternum mucrone saltatorio nullo, mesosterno receptum.

Segmenta ventralia duo priora concreta.

Procursus ventrales laterales epimera metathoracica attingentes, spiracula metathoracica in segmento mediali sita extrorsum cingentes; procursus ventralis medius inter coxas posticas ad mesosternum usque procedens.

Mandibulæ tetragonæ, crassæ, cochleariformes.

Alæ in longitudinem plicatæ.

Pedes ambulatorii trochanteribus posticis simplicibus, tarsis pulvillatis.

Oculi oblongi.

Tracheæ vesiculosæ. Glandulæ salivales in capite sitæ, filiformes, fasciculato-ramosæ. Ventriculus chylificus bicornis, parte postica in spiram convoluta. Vasa malpighiana terna, apice intestino ileo affixa. Folliculi testiculorum scroto inclusi, gracillimi, longissimi, apice conjunctim in spiram contorti; vesiculæ seminales binæ. Receptaculum seminis feminæ simplex, glandula appendiculari nulla. Systema nervorum: ganglion mesothoracis, cum ganglio metathoracis concretum; ganglia abdominalia quinque, duo priora in thorace sita; ganglion abdominale primum a ganglio metathoracico discretum.

Mandibulæ acie et fimbriis carentes, fovea articulari superiore ampla, condylo inferiore magno, prominente, collo distincto, capite globoso. Maxillæ malis coriaceis, dense breviter spinulosis. Lingua coriacea, crassa, pulvinata, integra, obtusa, spinulosa, stipite nullo. Antennæ poriferæ. Prosternum procursu labiali proprio nullo.

Tribus **Anthaxiini.**

Mandibulæ depressiusculæ, apice lobatæ, lobo terminali introrsum sub apicem profunde excavato.

Partes oris graciliores; malæ maxillarum triangulæ.

Sulci antennarii nulli.

Areæ poriferæ antennarum in parte articulorum inferiore sitæ, deorsum spectantes.

(Œsophagus sacculis utrinque appendiculatus.)

Chrysobothris, Eschltz.

Palpi maxillares articulo secundo elongato, terminali subcylindrico, truncato, pænultimum non complente. *Palpi labiales* clavati, articulo ultimo truncato. *Mentum* trapezoideum, transversum, fulcro brevi. *Lingua* ampla, late rotundata. *Antennæ* articulo primo et tertio productis, deinde profunde serratæ, areis poriferis concavis. *Femora* prima dentata. *Tibiæ* primæ et mediæ incurvæ. *Pronotum* basi lobatum.

(The space between the eyes in front much narrower towards the top. The coxal process of the prosternum broad. Scutellum elongated, triangular, pointed. First tarsal joint elongated. Second, third, and fourth abdominal segments with denticulated hind corners; fifth joint with a keel in the middle.)

(*C. affinis*, Fabr., r.; *C. chrysostigma*, L., r.)

Melanophila, Eschltz.

Palpi maxillares articulo secundo brevi, terminali cylindrico, truncato, pænultimum superante. *Palpi labiales* clavati, articulo ultimo brevi, crassissimo, truncato. *Mentum* transversum, utrinque rotundatum, fulcro amplissimo. *Lingua* apicem versus angustata. *Antennæ* graciles, ab articulo tertio vel quarto obtuse serratæ, areis poriferis convexis. *Tibiæ* rectæ. *Pronotum* basi lobatum.

(The space between the eyes in front slightly narrower towards the top. The coxal process of the prosternum broad, with three points. Scutellum small, triangular, with round corners. The abdominal segments without teeth.)

(*M. cyanea*, Fabr., in timber-yards; *M. appendiculata*, Fabr., r.)

Anthaxia, Eschltz.

Palpi maxillares articulo ultimo ovato, apice truncato. *Palpi labiales* filiformes, articulo ultimo conico, sesqui minore quam pænultimo. *Mentum* trapezoideum, transversum, fulcro brevissimo. *Lingua* late rotundata. *Antennæ* inde ab articulo quarto profunde serratæ, areis poriferis convexis. *Tibiæ* rectæ. *Pronotum* basi truncatum.

(First pair of femora without tooth. Scutellum equilateral, triangular. Prosternal spine broad, with truncated point. Abdominal segments edentate.)

(*A. quadripunctata*, L., in timber-yards.)

Tribus Buprestini.

Mandibulæ cuneiformes, apice integræ, parte interiore tota profunde excavata, margine cavernæ utroque denticulato.

Mentum breve, transversum, utrinque rotundatum, medio profunde emarginatum, fulcro labii amplo.

Maxillæ mala exteriore ampla, fornicata, cardine piriformi, libero.

Palpi maxillares articulo secundo brevi, terminali clavato, truncato, pænultimum superante.

Palpi labiales integri, clavati.

Areæ poriferæ antennarum in parte posteriore vel in utroque latere articulorum sitæ.

BUPRESTIS, L.

Antennæ breviores, profunde serratæ; areæ poriferæ minutæ, rotundatæ, profunde foveolatæ, sub angulum inferiorem lateris posterioris articulorum sitæ. *Prosternum* pone coxas anticas utrinque angulatum. *Epimera* mesothoracica margine priore subrecto.

(*B. mœsta*, Fabr., in timber-yards.)

CHALCOPHORA, Sol.

Antennæ graciliores, obtuse serratæ; areæ poriferæ amplæ, oblongæ, vix excavatæ, marginem inferiorem articulorum æquo intervallo sequentes, in utroque latere obviæ. *Prosternum* pone coxas anticas utrinque angulatum. *Epimera* mesothoracica margine anteriore angulato.

(*Ch. mariana*, L., in timber-yards.)

ANCYLOCHIRA, Eschltz.

Antennæ graciliores, obtuse serratæ; areæ poriferæ majores, profunde excavatæ, in angulo inferiore lateris posterioris articulorum sitæ. *Prosternum* sensim acuminatum. *Epimera* mesothoracica margine anteriore subrecto. *Tibiæ* anticæ maris uncinatæ.

(1. *A. splendida*, Payk., r.; 2. *A. rustica*, L.; and 3. *A. punctata*, Fabr., all three in timber-yards; 4. *A. flavomaculata*, Fabr., r.)

Tribus **Agrilini.**

Mandibulæ cuneiformes, apice integræ, parte interiore tota profunde excavata; marginibus cavernæ inermibus.

Maxillæ cardine gracili, elongato, sub mentum condito, malis obtusis.

Fulcrum labii evanidum.

Palpi labiales manci, articulo primo vel binis prioribus evanidis.

Sulci antennarii capiti sub oculos impressi.

Areæ poriferæ antennarum profunde excavatæ, in latere posteriore articulorum sub apicem sitæ.

Pronotum basi lobatum.

Agrilus, Meg.

Mandibulæ acutæ. *Palpi maxillares* filiformes, articulo ultimo fusiformi, truncato. *Mentum* triangulum. *Palpi labiales* biarticulati, articulo ultimo elongato, subcylindrico, truncato. *Antennæ* inde ab articulo quarto serratæ. *Sulci antennarii* brevissimi, in tempora non continuati. *Tarsi* postici longitudine tibiarum, articulo primo producto. *Unguiculi* dentati. *Scutellum* manifestum, basi transversum, postea subito acuminatum. *Epipleuræ prothoracicæ* carinatæ. *Corpus* productum.

(1. *A. viridis*, L., m. fr.; 2. *A. angustulus*, Illig., m. fr.; 3. *A. laticornis*, Illig., r.)

Trachys, F.

Mandibulæ obtusæ, foveola interiore amplissima. *Palpi maxillares* clavati, articulo ultimo magno, ovato. *Mentum* triangulum, latere utroque angulato. *Palpi labiales* biarticulati, subcylindrici, articulo ultimo brevi. *Antennæ* inde ab articulo septimo serratæ. *Sulci antennarii* in tempora continuati. *Tarsi* brevissimi. *Unguiculi* dentati. *Scutellum* minutissimum triangulum. *Corpus* breve.

(1. *T. minuta*, L., m. fr.; 2. *T. troglodytes*, Gyll., r.)

*Aphanisticus, Latr.

Mandibulæ acutissimæ. *Palpi maxillares* clavati, articulo ultimo ovato. *Mentum* breve, transversum, utrinque rotundatum. *Palpi labiales* unico constantes articulo elongato, subcylindrico. *Antennæ* inde ab articulo octavo serratæ. *Sulci antennarii* in tempora et epimera prothoracis continuati. *Tarsi* brevissimi. *Unguiculi* inermes. *Scutellum* minutissimum, triangulum. *Corpus* productum. *Tempora* producta, oculis multo longiora. *Femora* dilatata.

(*A. pusillus*, Oliv., r.)

ELATERIDÆ.

(Tarsi quinquearticulati. Antennæ filiformes. Corpus durum. Coxæ anticæ globosæ. Coxæ posticæ transversæ, fixæ. Prosternum processu postico producto.)

Epimera mesothoracica epimera prothoracica non attingentia, articulo cum prothorace non conjuncta.

Prosternum aut supra sub apicem mucrone armatum saltatorio, aut in mucronem saltatorium sensim transiens. Mesosternum fovea profunda mucronem excipiens.

Procursus ventrales epimera metathoracica non attingentes, spiracula metathoracica extrorsum libera, inter epimera et procursus ventrales sita; procursus ventralis medius brevis, ad metasternum vix procedens.

Mandibulæ triquetræ, fornicatæ, apicem versus extenuatæ.

Alæ in longitudinem et transverse plicatæ.
Pedes cursorii trochanteribus posticis fulcientibus.
Oculi rotundati.

Tracheæ vesiculis carentes. Glandulæ salivales propriæ nullæ. Ventriculus chylificus simplex, subrectus. Vasa malpighiana bina, apice libera. Folliculi testiculorum scroto carentes, oblongi vel globosi; vesiculæ seminales ternæ, structura maxime variantes. Receptaculum seminis feminæ structura valde varians, sæpissime duplex aut multiplex, glandula appendiculari magna, sæpissime ramosa. Systema nervorum: ganglia thoracica discreta; ganglia abdominalia octo, duo priora in thorace sita; ganglion abdominale primum ganglio metathoracico applicatum.

Sectio Prima.

Mandibulæ fimbriis carentes. Scrobiculi antennarii genis impressi. Prosternum procursu labiali nullo.

(Epimera mesothoracica coxas attingentia. Epipleura elytrorum costa laterali obtusa. Segmenta ventralia præter terminale immobilia).

Tribus 1. **Melasini.**

Mandibulæ basi tumidæ, parte interna excavata; condylo interiore maximo, fovea articulari superiore amplissima.

Maxillæ stipite palpigero distante, articuliformi, mala unica, tenui, apice brevissime barbata.

Lingua minuta, integra, obtusa, stipite nullo.

Palpi clavati, articulo ultimo magno, ovato.

Prothorax sulcis antennariis nullis; prosternum processu postico acuto, mucrone saltatorio valde discreto, sursum ascendente.

Melasis, Oliv.

Mandibulæ acutæ, basi valde tumidæ, tumore supra rotundato. *Palpi maxillares* articulo ultimo apice summo truncato, articulum terminalem palporum labialium duplo superante. *Palpi labiales* articulo primo tenui, secundum longitudine superante. *Mentum* breve, transversum. *Antennæ* serratæ, basi distantes. *Tibiæ* compresse dilatatæ; *tarsi* compressi, articulo quarto integro. *Coxæ posticæ* lamina femorali ampla, extrorsum emarginata. *Segmentum* ultimum ventris apice compresse carinatum.

(*M. Buprestoides*, L., m. fr.)

Xylobius, Latr.

Mandibulæ trilobæ, lobo intermedio introrsum excavato, basi tumidæ, tumore dorso corniculato. *Palpi* subæquales, articulo ultimo maximo. *Mentum* trapezoideum. *Antennæ* teretes, basi vicinæ.

Tibiæ teretes. *Tarsi* graciles, articulo quarto trilobo. *Segmentum* ultimum ventris apice rotundatum.

(*X. Alni*, Fabr., m. fr.)

Tribus 2. **Eucnemidini.**

Mandibulæ introrsum carinatæ.

Maxillæ malis binis, membranaceis, breviter barbatis.

Lingua lata, tenuis, membranacea, emarginata, stipites palporum labialium non multum excedens, stipite evanido.

Palpi securiformes.

Mentum transversum, trapezoideum.

Sulci antennarii in epimera prothoracis plus minusve continuati.

Prosternum mucrone saltatorio sursum ascendente.

Eucnemis, Ahr.

Mandibulæ acutæ, integræ, fovea articulari superiore amplissima, condylo inferiore maximo. *Palpi maxillares* articulo terminali maximo, pænultimum sesqui superante, apice recte truncato. *Palpi labiales* articulo terminali maximo, articulum ultimum palporum maxillarium sesqui superante, angulo interiore producto. *Sulci antennarii* epimerorum marginales, valde profundi. *Coxæ* posticæ lamina femorali ampla, post acuminata. *Prosternum* processu postico acuminato. *Mentum* subquadratum.

(*E. capucinus*, Ahr., r.)

Microrhagus, Chevrol.

Mandibulæ trilobæ, dorso inferiore corniculato. *Palpi maxillares* articulo terminali maximo, pænultimum duplo superante, apice oblique truncato, angulo exteriore valde producto. *Palpi labiales* articulo terminali dimidiam palporum maxillarium articuli ultimi magnitudinem vix superante, angulo exteriore producto. *Sulci antennarii* epimerorum ad suturas prosternales levius excavati. *Coxæ* lamina femorali brevi, introrsum dilatata, post rotundata. *Prosternum* processu postico acuminato. *Mentum* trapezoideum.

(*M. pygmæus*, Fabr., r.)

Throscus, Latr.

Mandibulæ integræ, acutæ, acie tenui, utrinque minute mucronulata. *Palpi* articulo terminali magno, oblique truncato. *Sulci antennarii* prothoracis angulati, integri. *Coxæ* posticæ lamina femorali brevi, truncata. *Prosternum* processu postico marginato, apice rotundato, mucrone saltatorio obtecto. *Mentum* subquadratum, processu medio acuto. *Tarsi* articulo quarto bilobo. *Antennæ* ab articulo nono tantum serratæ, clavam simulantes.

(1. *T. dermestoides*, L., fr.; 2. *T. obtusus*, Curtis, r.)

Sectio Secunda.

Mandibulæ fimbriatæ. Scrobiculi antennarii capitis nulli. Prosternum procursu labiali manifesto, ab epimeris incisura acuta utrinque discreto.

Tribus 3. **Elaterini.**

Mandibulæ bifidæ.

Maxillæ malis binis, triangulis, dense barbatis.

Mentum trapezoideum.

Lingua ampla, tenuis, membranacea, barbata, stipites palporum labialium valde excedens, biloba, lobis arcte contiguis, stipite angusto, corneo.

Prosterni processus posticus plerumque acuminatus, mucrone saltatorio retroverso, processum superante, vel in mucronem saltatorium sensim transiens.

I. Segmenta ventralia cornea, præter terminale immobilia. Scrobiculi femorales prothoracis foris occlusi. Mesosternum apice bifidum. Oculi immersi.

A. Epimera mesothoracica coxas non attingentia.

a. Sulci antennarii prothoracis nulli.

CARDIOPHORUS, Eschltz.

Prosternum processu postico brevissimo, mucrone saltatorio crasso. *Coleoptera* prothoraci innata. *Scutellum* cordatum, sulcatum.

(1. *C. ruficollis*, L., m. fr.; 2. *C. asellus*, Erichs., m. fr.)

CRYPTOHYPNUS, Eschltz.

Prosternum processu postico elongato, in mucronem saltatorium sensim transiens. *Coleoptera* prothoraci superposita. *Scutellum* triangulum, integrum.

(1. *C. quadripustulatus*, Fabr., fr.; 2. *C. sabulicola*, Boheman, r.; 3. *C. pulchellus*, L., fr.)

b. Sulci antennarii prothoracis profundi, antennas curvatas excipientes.

LACON, Latr.

Prosternum processu postico elongato, mucrone saltatorio producto. *Coleoptera* prothoraci innata.

(*L. murinus*, L., fr.)

B. Epimera mesothoracica coxas attingentia.

a. Sulci antennarii prothoracis profundi, antennas totas excipientes.

LISSOMUS, Dalm.

Sulci antennarii prothoracis decurtati, antennas curvatas exci-

pientes. *Prosternum* processu postico marginato, apice rotundato, mucrone saltatorio obtecto. *Tarsi* articulis ternis intermediis pulvillatis.

(*L. equestris,* Fabr., r.)

ADELOCERA, Latr.

Sulci antennarii prothoracis integri, antennas directas excipientes. *Prosternum* processu postico elongato, in mucronem saltatorium sensim transiens. *Tarsi* pulvillis carentes. *Episterna metathoracica* epipleuris elytrorum tota obtecta.

(*A. lepidoptera,* Panz., in timber-yards, r.)

b. Sulci antennarii prothoracis brevissimi, obscuri vel nulli.

α. Unguiculi serrati. Antennæ areis poriferis manifestis. Elytra costa laterali evanida.

MELANOTUS, Eschltz.

Palpi securiformes. *Prosternum* processu postico crasso, in mucronem saltatorium sensim transiens. *Sulci antennarii* prothoracis brevissimi. *Frons* laminata.

(1. *M. niger,* Panz., r.; 2. *M. brunnipes,* Germ., r.; 3. *M. castanipes,* Payk., fr.[1])

ADRASTUS, Meg.

Palpi articulo terminali acuminato. *Prosternum* processu postico acuto, mucrone saltatorio valde discreto. *Sulci antennarii* prothoracis nulli. *Frons* deflexa.

(*A. limbatus,* F., fr.)

β. Unguiculi inermes.

† Tarsi pulvillis carentes.

ELATER, L.

TABULA SYNOPTICA SUBGENERUM.

1. Prosterni processus posticus mucrone saltatorio manifesto, discreto. Elytra costa laterali evanida.
   A. Sulci antennarii prothoracis brevissimi.
      a. Frons deflexa.
         * Epimera prothoracis dentata. Anguli antici prothoracis deflexi. Antennæ utriusque sexus areis poriferis manifestis.

1. *Agriotes,* Eschltz.

(1. *E. aterrimus,* L., fr.; 2. *E. pilosus,* Panz., r.; 3. *E. pallidu-*

[1] A. The eyes granulated; posterior corners of the pronotum with short dorsal ridge; hind feet not longer than tibiæ; hairy covering of antennæ the same in both sexes (*M. niger, M. brunnipes*). B. Eyes smooth, the ridge on the hind corners of pronotum continued forwards along the sides; hind feet longer than tibiæ; antennæ of male woolly underneath (*M. castanipes*). Prof. Schiödte does not admit *Cratonychus rufipes,* Erichs. (Germar, Zeits. iii. 96. 8) as a species distinct from *M. castanipes,* Payk., and states that *E. bicolor,* Fabr., is a very different, southern species.

lus, Illig., fr.; 4. ***E. sputator,*** L., fr.; 5. ***E. obscurus,*** L., fr.; 6. ***E. lineatus,*** L., fr.; 7. ***E. ustulatus,*** Schaller, r.; 8. ***E. marginatus,*** L., fr.[1])

** Epimera prothoracis inermia. Anguli antici prothoracis porrecti. Antennæ maris poris indigestis, feminis areis poriferis manifestis.

2. *Sericosomus,* Serv.

(***E. brunneus,*** L., m. fr.)

b. Frons laminata. Coxæ posticæ lamina femorali ampla, abrupte acuminata. Antennæ poris indigestis, infra crebrioribus.

3. *Ampedus,* Meg.

(1. ***E. sanguineus,*** Fabr., m. fr.; 2. ***E. coccineus,*** Germ., r.; 3. ***E. dibaphus,*** Schiödte, m. fr.; 4. ***E. cardinalis,*** Schiödte, r.[2]; 5. ***E. præustus,*** Fabr., m. fr.; 6. ***E. ephippium,*** Oliv., m. fr.; 7. ***E. crocatus,*** Castelnau, r.; 8. ***E. elongatulus,*** Fabr., fr.; 9. ***E. elegantulus,*** Germ., r.; 10. ***E. balteatus,*** L., fr.; 11. ***E. nigrinus,*** Payk, fr.; 12. ***E. æthiops,*** Boisd. & Lacord., r.)

B. Sulci antennarii prothoracis nulli.

a. Frons deflexa. Coxæ posticæ lamina femorali magna, sensim angustata. Antennæ areis poriferis manifestis.

4. *Ludius,* Latr.

(***E. ferrugineus,*** L., r.)

b. Frons laminata. Coxæ posticæ lamina femorali ampla, abrupte acuminata. Antennæ poris indigestis.

5. *Ischnodes,* Germ.

(***E. sanguinicollis,*** Panz., r.)

[1] The species are thus arranged:—A. Prosternal spine gradually pointed. Femoral lamina of posterior coxæ gradually narrowed. Pronotum longer than broad; *a.* lateral edges of pronotum entire, hind corners with sharp ridge. *Antennæ deeply serrated, as long as head and pronotum; eyes granulated (*E. aterrimus*). **Antennæ filiform, as long as head and pronotum; eyes smooth (*E. pilosus*). *b.* Side edges of pronotum interrupted in middle, hind corners without ridge; antennæ filiform, longer than head and pronotum; eyes granulated (*E. pallidulus*). B. Prosternal spine compressed behind the coxæ; antennæ filiform; †femoral lamina of posterior coxæ gradually narrowing; *a.* antennæ longer than head and pronotum; *pronotum longer than broad (*E. sputator*); ** pronotum broader than long (*E. obscurus* and *E. lineatus*). *b.* Antennæ shorter than head and pronotum; pronotum of equal length and breadth (*E. ustulatus*); †† femoral lamina of posterior coxæ pointed (*E. marginatus*).

[2] Prof. Schiödte rejects the earlier attempts at a separation of the species of this subgenus with entirely red elytra: he shows that the characters adopted are unstable, and more particularly that the triangular form of the third joint of the antennæ, on which Kiesenwetter founds his *A. satrapa,* is a sexual peculiarity, the second and third joints of the antennæ varying considerably in shape and size according to the sexes. The synonymy of the

2. Prosterni processus posticus in mucronem saltatorium sensim transiens. Elytra costa laterali manifesta.
   A. Epipleuræ elytrorum pone coxas posticas evanidæ.
      a. Sulci antennarii prothoracis nulli.
         α. Frons deflexa. Coxæ posticæ lamina femorali ampla.

6. *Megapenthes,* Kiesenw.

(*E. tibialis,* Boisd., r.)

β. Frons laminata.
   * Coxæ posticæ lamina femorali angusta, sensim acuminata.

7. *Pheletes,* Kiesenw.

(*E. Bructeri,* Fabr., r.)

** Coxæ posticæ lamina femorali ampla, abrupte acuminata.

8. *Hypolithus,* Steph.

(*E. riparius,* Fabr., m. fr.)

b. Sulci antennarii prothoracis brevissimi. Frons laminata.

9. *Limonius,* Eschltz.

(1. *E. minutus,* L., fr.; 2. *E. nigripes,* Gyll., m. fr.; 3. *E. cylindricus,* Payk., fr.)

B. Epipleuræ elytrorum manifestæ. Sulci antennarii prothoracis nulli vel levissimi. Frons descendens.

10. *Diacanthus,* Latr.

(1. *E. tessellatus,* L., fr.[1]; 2. *E. bipustulatus,* L., m. fr.; 3. *E.*

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two first-named species is uncertain. *E. cardinalis* was first discovered by Prof. Schiödte in Italy, but occurs also in Denmark. *E. dibaphus* ♂ has the third joint of the antennæ triangular. The four red species are distinguished principally by the proportions of length between pronotum, elytra, and antennæ. The elytra are in *E. sanguineus* twice and a half as long as the pronotum, in *E. cardinalis* rather less; in *E. dibaphus* the proportion is twice and three quarters, and in *E. coccineus* about three times. The antennæ are always about one-sixth shorter in the ♀ than in the ♂; in *E. sanguineus* ♂ they equal the pronotum to the point of the hind corners; in *E. dibaphus* ♂ and *E. coccineus* ♂ they exceed this measure not a little; but in *E. cardinalis* ♂ they are not longer than the pronotum measured along the middle line; in *E. cardinalis* the pronotum equals in length its own width measured over the hind corners, whilst it is shorter in the three other species, from which *E. cardinalis* is also distinguished by the punctures being much coarser on the head and pronotum, which are quite dull, and by the sides of the body being parallel in the middle. The transversal dip at the base of the pronotum is very marked in all these species except *E. coccineus,* where it is strikingly flat and shiny; but the extent and depth of the middle groove varies in all four species. Nor is the colour of the hairs of any value for the distinction of these difficult species. The antennæ are black in *E. sanguineus* and *E. dibaphus,* brown in *E. cardinalis,* and light brown in *E. coccineus.*

[1] Linné's *E. tessellatus* (Fauna Suec. 739) has, since the time of Olivier,

cinctus, Payk., m. fr.; 4. *E. quercus,* Gyll., r.; 5. *E. æneus,* L., fr.; 6. *E. cruciatus,* L., m. fr.; 7. *E. impressus,* Fabr., r.; 8. *E. metallicus,* Payk.; 9. *E. sjælandicus,* r.; 10. *E. pectinicornis,* L., fr.; 11. *E. castaneus,* L., m. fr.[1])

†† Tarsi pulvillati.

Athous, Eschltz.

Prosterni processus posticus in mucronem saltatorium sensim transiens. *Elytra* costa laterali manifesta. *Sulci antennarii* prothoracis nulli. *Frons* laminata.

(1. *E. mutilatus,* Rosenhauer, r.; 2. *E. niger,* L., fr.; 3. *E. rhombeus,* Oliv., r.; 4. *E. ruficaudis,* Gyll., fr.; 5. *E. vittatus,* Fabr., fr.; 6. *E. subfuscus,* Gyll., fr.)

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generally been misunderstood; and the species thus named by Linné has been called *E. holosericeus,* Oliv., whilst the Linnean name has been given to a different species, which Linné most probably confounded with *E. pectinicornis* ♀, but which Müller describes in his 'Fauna Fredrichsdalina' under the name of *E. sjælandicus.* Prof. Schiödte has now restored the original names to the proper species, and corrected the error which seems to be founded on a mere mistake of Olivier's.

[1] The species are thus classified:—A. Indistinct antennal grooves near the margins of the prothorax; antennæ serrated from the fourth joint; the anterior corners of the pronotum prominent, pointed, somewhat flattened, the posterior corners short, obtuse, with obsolete ridge. The posterior margin of epimera prothoracica slightly arched and undulated; prosternal spine short, thick; claw-joint of third pair of tarsi longer than their first joint (*E. tessellatus*). B. No antennal grooves; *a.* antennæ serrated from the fourth joint; * hind corners of pronotum without ridge; anterior corners of pronotum deflected, the posterior margin of pronotum obtusely bidentate; prosternal spine short, thick; legs slender; claw-joint of hind tarsi a little longer than the first joint (*E. bipustulatus*); ** hind corners of pronotum with sharp ridge; † posterior margin of epimera prothoracica bidentate, the inner tooth pointed; anterior corners of pronotum more or less deflected; prosternal spine long, thin, pointed; legs slender; claw-joint of third pair of tarsi longer than the basal joint (*E. cinctus, E. quercus*); †† posterior margin of epimera prothoracica angulate or obtusely bidentate; anterior corners of pronotum pointed, produced; prosternal spine long, gradually acuminated, with a more or less prominent knob before the point; legs powerful; claw-joint of hind tarsi club-shaped, longer than basal joint; claws long and powerful; § posterior margin of epimera prothoracica angulate; antennæ with small, lightly impressed, poriferous spots (*E. æneus*); §§ posterior margin of epimera prothoracica obtusely bidentate; antennæ without poriferous spots (*E. cruciatus, E. impressus, E. metallicus*). *b.* antennæ serrated from the third joint; anterior corners of pronotum produced, pointed; scutellum cordate; legs powerful; claw-joint of third pair of tarsi club-shaped, longer than basal joint; claws long, powerful; * posterior margin of epimera prothoracica arched, slightly undulated; prosternal spine long; posterior corners of pronotum ridged (*E. sjælandicus, E. pectinicornis*); ** posterior margin of epimera prothoracica obtusely bidentate; prosternal spine short; hind corners of pronotum without ridge (*E. castaneus*).

II. Segmenta ventralia margine laterali membranacea, mobilia. Scrobiculi femorales prothoracis foris aperti. Mesosternum apice acutum. Oculi exserti.

Campylus, Fisch.

Elytra prothoraci superposita. *Epimera* mesothoracica coxas attingentia. *Oculi* exserti, granulati. *Frons* laminata. *Sulci antennarii* nulli. *Prosterni* processus in mucronem saltatorium sensim transiens. *Coxæ* posticæ lamina femorali angustissima. *Elytra* costa marginali integra, planiuscula, recta, post coxas posticas non inflecta. Segmentum quintum abdominis in femina post rotundatum, in mare truncatum, medio productum, segmentum sextum haud obtegens.

(1. *C. linearis*, L., fr.; 2. *C. denticollis*, Fabr., r.)

MISCELLANEOUS.

Scheuchzeria palustris, Linn.

To the Editors of the Annals and Magazine of Natural History.

Gentlemen,—With great pleasure I am enabled to record that the Rev. O. M. Fielden, incumbent of Welsh Frankton, Shropshire, has this summer (1866) detected this rare plant growing in Welsh Hampton Moss, Shropshire, and thus has added a second Shropshire locality, and a fifth British one. Only three specimens were found, one of which is now before me.

I am, Gentlemen, yours, &c.
W. A. Leighton.

Shrewsbury, Sept. 24, 1866.

On the Long-eared or Mule Deer of North America (Eucervus). By Dr. John Edward Gray, F.R.S., &c.

The Long-eared or Mule Deer of the Western States of North America are very imperfectly known in Europe; and the examination of the horns, which I had not before seen, has shown me that they have been very erroneously placed with the genus *Cariacus*. Dr. Spencer Baird, in his excellent work on the Mammals of North America, has formed for them a distinct section of his genus *Cervus*.

The *Cariaci* or Savanna Deer have the upper part of the beam of the horns curved forward, with the upper branches arising from its hinder edge; they generally have a single subbasal snag some distance from the base; and the outside of the metatarsus has a short broad gland. The skull is elongate, narrow, and the suborbital pit is small. The Mule Deer, on the contrary, have a doubly forked suberect horn, like the genera *Blastocerus* and *Furcifer* of South and tropical America. They differ from both these genera in having a large elongated gland on the outside of the metatarsus, rather differently formed horns, and a broad short skull.

To this group I propose to give the generic name of Eucervus.

It is characterized by the horns being doubly forked, the forks being nearly equal. There is sometimes a small snag on the inner side of the lower part of the beam; but this is often wanting. The outside of the metatarsus has a large elongated gland. Hoofs triangular, narrow. The skull broad; suborbital pit large, triangular. The skulls of both sexes are described in my 'Catalogue of Ungulate Mammalia in the British Museum,' p. 283. There are two well-described species found in the Western States of North America, viz.:—

1. Eucervus macrotis.

Cervus macrotis, Say; Spencer Baird, Mamm. N. A. 657, f. 19, 20 (horns), t. 23. f. 1 (feet).
C. auritus, Warden.

Rump white. "Tail cylindrical, a little longer than the ears, very slender, naked beneath, except at the end, which is a black tuft."

2. Eucervus Columbianus.

Cervus Columbianus, Richardson, F. B.-A. t. 20; Spencer Baird, Mamm. N. A. 659, f. 22, 23 (horns), t. 23. f. 2 (feet).
?*C. Lewisii*, Peale.

Rump like back. "Tail cylindrical, hairy and white beneath, almost entirely black at the base."

Mr. Titian Peale describes the hoofs of his Mule Deer as different from those of the Black-tailed Deer; but Dr. Spencer Baird says that the hoofs of both the species he describes were alike and slender; so that perhaps Mr. Peale's animal may be a third species of the genus, characterized by the hoof, like the Elk and the Wapiti.

On the Development of the Myzostoma. By E. Mecznikoff.

The *Myzostoma*, parasites of the *Comatulæ*, notwithstanding repeated investigations, still occupy an uncertain position in the zoological scale. The most recent observers, such as M. Semper, seem inclined to approximate them to the Arthropoda.

The author has arrived at a different conclusion. It is among the Annelids that he seeks the nearest allies of the *Myzostoma*, founding this view upon the development of the parasite, which he has been able to investigate partially by the aid of artificial fecundation. The young larva, which is at first ciliated, soon presents rudiments of setigerous pedal rami. Such a larva certainly presents no resemblance to a *Nauplius*, nor does it possess the facies of an Acarian or Tardigrade, which has been supposed to be recognizable in the figures given by Semper.

The *Myzostoma* would therefore be parasitic Annelids. Their skin, moreover, presents a structure similar to that of Annelids, inasmuch as its cuticle is set with bundles of vibratile cilia, a character which is not presented by other classes of worms. The papilliferous trunk of the *Myzostoma* is hardly to be discriminated from that of the *Geryones* or *Phyllodoceæ*. Their ramified intestine is merely a

repetition of that of the *Aphroditaceæ*. Their feet are simple rami, which have no relation to the limbs of the Arthropoda.

It must, however, be admitted that the reproductive organs of the *Myzostoma* differ considerably from those of the true Annelids. Leaving out of consideration their hermaphroditism, which occurs also among certain polychætous Annelids, the existence of a cloaca deserves to be especially indicated.

The deferent canals are also exceptional, at least unless we compare them with the segmentary organs of those Chætopoda which have only a single pair (*Parthenope*). The existence of ventral suckers is a peculiarity of little importance, and in accordance with the conditions of parasitism. Moreover a sucking-disk is met with in the *Leucodoræ* among Chætopoda.—*Zeitschr. für wiss. Zool.* xvi.; *Bibl. Univ.* 1866, *Bull. Sci.* p. 153.

On the Synonymy and Geographical Distribution of Jussiæa repens (*Linn.*). By C. Martins.

Having for the last four years cultivated one of the species of *Jussiæa* under the most varied conditions of dryness and moisture and shade and light, I have been able to demonstrate how the form, the size, the pubescence of the leaves, the size of the flowers, and, indeed, the entire habit of the plant were subject to vary. After having familiarized myself with all these forms, I consulted the herbaria, and personally visited those of the museum and of MM. Delessert and Cosson at Paris, of Delile and Cambessides at Montpellier, and of M. de Candolle at Geneva. Dr. Hooker, at my request, was good enough to go through that of Kew, and M. Boissier that which he possesses at Geneva. From this examination it results that *Jussiæa repens*, described by Linné in 1747*, has since received twelve different names: namely, *J. adscendens*, Linn.; *J. diffusa*, Forsk.; *J. grandiflora*, Mich.; *J. peploides*, H. J. Kunth; *J. fluvialis*, Blume; *J. ramulosa*, De C.; *J. swartziana*, De C.; *J. stolonifera*, Guill. et Per.; *J. alternifolia*, E. Meyer; *J. australatica*, Ferd. Müll.; and *J. fluitans*, Hochst.

I am not the first botanist who has perceived that some of these names do not represent species, but simple varieties. Linné, De Candolle, Sir William Hooker, Schiede and Ehrenberg, Torrey and Asa Gray, Hasskarl, Miguel and Grisebach each united some of them, but without regarding them all as mere modifications of one and the same specific type.

This multifarious synonymy has nothing extraordinary in it; it may be explained by the immense area which *Jussiæa repens* occupies on the surface of the globe, as much as by the variability of its form, every botanist hesitating to recognize an Indian species in an African, American, or Australian plant. This great extension justifies the law laid down in the first place for Lapland alone by Linné†, and since extended to the whole world by A. de Candolle‡—namely,

* Flora Zeylanica, p. 75. † Flora Lapponica, Prolegomena, § 31.
‡ Géographie botanique, p. 1005.

that the aquatic plants have the most extended area. Setting books aside, I have been able to follow this species from station to station, by means of the authentic specimens deposited in the herbaria, in Asia, Oceania, Africa, and America. In Africa it extends without interruption from Bône (in Algeria) to the Cape of Good Hope, over 61 degrees of latitude, and in longitude from the mouths of the Senegal to the islands of Mauritius and Réunion—that is to say, over 73 degrees. In Asia I have myself collected this plant in the marshes of Alexandretta in Syria, and it may be traced into India as far as Ceylon, and across the archipelago of the Philippines and the Sunda Islands as far as the south of Australia. This area includes 112 degrees of longitude and 73 degrees of latitude. In America the extreme points are, in the north Kentucky, and in the south the Rio de la Plata, giving 72 degrees; and from east to west Mexico and Bahia, or 60 degrees of longitude.

Thus *Jussiæa repens* occupies a broad band passing all round the globe, of which the two extreme borders parallel to the equator, in the northern and southern hemispheres, are distant each 35 degrees from the equinoctial line.

Further investigations pursued in the same spirit will probably show that this example is not isolated; and already M. Ernest Cosson* has indicated an aquatic grass, *Leersia hexandra,* Swartz, the geographical extension of which is not less, and its botanical synonymy equally complicated.—*Comptes Rendus,* 9th July, 1866, pp. 39–41.

Note on a Regular Dimerous Flower of Cypripedium candidum. By Asa Gray.

Mr. J. A. Paine, junr., of New York, who two years ago detected an interesting monstrosity of *Pogonia ophioglossoides,* has now brought to me, preserved in spirit, a monstrous blossom of *Cypripedium candidum,* which demands a record.

The plant bears two flowers: the axillary one is normal; the terminal one exhibits the following peculiarities. The lower part of the bract forms a sheath which encloses the ovary. The labellum is wanting; and there are two sterile stamens, the supernumerary one being opposite the other, *i. e.* on the side of the style where the labellum belongs. Accordingly the first impression would be that the labellum is here transformed into a sterile stamen. The latter, however, agrees with the normal sterile stamen in its insertion as well as in shape, being equally adnate to the base of the style. Moreover the anteposed sepal is exactly like the other, has a good midrib and an entire point. As the two sterile stamens are anteposed to the two sepals, so are the two fertile stamens to the two petals, and the latter are adnate to the style a little higher than the former. The style is longer than usual, is straight and erect; the broad, disciform stigma therefore faces upwards; it is oval and symmetrical, and a light groove across its middle shows it to be

* Flore Algérienne, 4to, t. i. p. 18.

dimerous. The placentæ, accordingly, are only two. The groove on the stigma and the placentæ are in line with the fertile stamens.

Here, therefore, is a symmetrical and complete, regular but dimerous orchideous flower, the first verticil of stamens not antheriferous, the second antheriferous, the carpels alternate with these; and here we have clear (and perhaps the first direct) demonstration that the orchideous type of flower has two stamineal verticils, as Brown always insisted.—*Silliman's Journal*, September 1866.

Boussingault's Researches on the Action of Foliage.

A full abstract of the first part of these investigations, communicated to the French Academy of Sciences, is given in the 'Comptes Rendus,' vol. lx. no. 18 (May 1865). Theodore Saussure had long ago ascertained that, while plants prosper and decompose carbonic acid gas in an atmosphere containing as much as one-twelfth or even one-eighth part of that gas, they promptly perish in unmixed carbonic acid, apparently without decomposing any of it. Boussingault made his experiments in a better form, upon leaves only, avoiding all complication of the action of the roots or other parts of the plant. His results are:—

1. That leaves exposed to sunshine in pure carbonic acid do not decompose this gas at all, or only with extreme slowness.

2. But in a mixture with atmospheric air, they decompose carbonic acid rapidly. The oxygen of the atmospheric air, however, appears to play no part.

3. Leaves decompose carbonic acid in sunshine as readily when this gas is mixed with nitrogen or with hydrogen.

Although this decomposition of carbonic acid by green foliage must be a case of dissociation—a separation of carbon from oxygen—yet Boussingault recognizes an analogy here with an opposite phenomenon, viz. with the slow combustion of phosphorus at the ordinary temperature. Phosphorus in pure oxygen emits no light, does not sensibly undergo combustion, but does so in a mixture of oxygen with atmospheric air, or with nitrogen, hydrogen, or carbonic acid. The analogy may even be carried further; for while a stick of phosphorus is not phosphorescent in pure oxygen at ordinary or increased pressure, it becomes so in rarified oxygen. And Boussingault equally ascertained that leaves which exerted no sensible action upon pure carbonic acid at ordinary pressure, decomposed it, with the liberation of oxygen gas, under diminished pressure. That is, rarefaction and mixture with an inert gas act alike in mechanically separating the atoms, whether of carbonic acid, as in the one case, or of oxygen, as in the other, so as to determine the action either of combination or of dissociation.

In a continuation of these investigations (Comptes Rendus, vol. lxi., Sept. 25, 1865), Boussingault shows that carbonic oxide, whether pure or diluted, is not decomposable by foliage, and that this inertness of green foliage upon carbonic oxide goes to confirm the opinion maintained in his 'Economie Rurale,' that leaves simultaneously de-

compose carbonic acid and water, $CO^2, HO = CO, H, O^2$: the O^2 being liberated, CO, H expresses the relation under which carbon is united with the elements of water in cellulose, starch, sugar, &c., *i. e.* in the important principles elaborated by the leaves, the composition of which is represented by carbon and water. He goes on to prove that a leaf which has been decomposing carbonic acid and water all day long is capable of doing the same work the next day, if not allowed to dry; but the losing of a certain amount of water annihilates this faculty, and irremediably destroys the life of the cells of a leaf, vegetable life in this state being far less tenacious than that of some of the lower animals (Tardigrades, *Notipes*, &c.), which bear wonderful desiccation.

The third instalment of the investigation is given in Nos. 16 and 17 of the same volume (Oct. 16 and 23, 1865). It appears that detached leaves, kept in shade for many days, with the cut end of the petiole in water to prevent desiccation, preserve the power of decomposing carbonic acid whenever brought into sunshine. But for this they must be kept in an atmosphere containing a supply of oxygen; without this they soon die, as Boussingault thinks, from asphyxia. This oxygen in darkness is slowly transformed into carbonic acid, through an operation which is presumed to go on continually, whether in light or darkness, and to answer to respiration. Of course a healthy and active leaf decomposes far more carbonic acid in the light than it forms in darkness. In eighteen experiments with oleander-leaves exposed to the sun from 8 A.M. to 5 P.M. in an atmosphere rich in carbonic acid, a square metre of foliage decomposed on the average over a litre of carbonic acid per hour, while in darkness only $\frac{7}{100}$ of a litre of carbonic acid was produced per hour. In air which contains oxygen and carbonic acid, leaves will go on indefinitely producing oxygen in the presence of carbonic acid, and carbonic acid in the presence of oxygen. But the latter, though relatively small in amount, seems to be necessary to the preservation of their vitality. In hydrogen, carburetted hydrogen, or nitrogen, as well as in pure carbonic acid, they soon lose their decomposing power, and die from the impossibility of respiration, *i. e.* are asphyxiated.

Leaves confined in a limited portion of atmospheric or other air over mercury lose the power of decomposing carbonic acid; and the experiments pretty clearly show that they lose it through the deleterious action of the vapour of mercury. It is thought remarkable that the leaf does not under these circumstances at all lose the power of transforming oxygen into carbonic acid; but that is what we should expect; for the carbonic acid so evolved (whether its evolution be called respiration or not) must be a product of decomposition of the leaf's contents or substance.

We owe to Boussingault and his assistant Lewy the idea of determining the composition of the air contained in a fertile soil, and the fact that this air in a strongly manured soil contains a very large percentage of carbonic acid. Boussingault has now devised an experiment by which the air contained in a branch of an oleander in full vegetation was extracted. It proved to be, nitrogen 88·01 per

cent., oxygen 6·64 per cent., carbonic acid 5·35 per cent., being about the composition of the air from a well-manured soil. This carbonic acid carried into the leaves with the sap, and also that which they may absorb directly from the atmosphere, decomposed along with water under sunlight, must be the source of the glucose ($C^{12} H^{12} O^{12}$) which it is the principal function of foliage to produce. This glucose, in fixing or abandoning the elements of water, becomes sugar, starch, cellulose, or other hydrates of carbon, which, in whatever part of the plant accumulated or deposited, and however transformed or retransformed, must always have originated from carbonic acid and water in the green parts of plants. In closing his present paper with some illustrations of this now familiar view, Boussingault announces that his more recent experiments will enable him to demonstrate the direct formation of saccharine matter by the green parts of vegetables exposed to the light.—Silliman's *American Journal*, July 1866.

Observations on a Malady of the Cotton-plant, called "Pelagra," and on some Fungi which accompany it. By G. Gasparrini.

In the summer of 1863 some cotton-plants cultivated in the province of Naples were attacked by a disease which alarmed the cultivators, who have become frightened about the attacks of Mucedineæ, in consequence of the ravages of *Oïdium*. The author examined the blackened stems of the plants attacked, and detected several Fungi of the family Mucedineæ—amongst others *Alternaria tenuis*. This production did not appear to him to be autonomous, but one of the conidic forms of a small fungus of higher order, namely *Pleospora* (*Sphæria*) *herbacea*. He regards *Penicillium glaucum* as a gonidic form of *Alternaria*. These, however, are pure hypotheses.

M. Gasparrini does not attribute the disease of the cotton-plant to these plants, but considers it to be due to meteorological conditions.—*Bibl. Univ.* 1866, *Bull. Sci.* p. 167.

Fossil Medusæ.

Professor Haeckel of Jena, who in 1865 called attention to the existence of well-preserved Medusæ in the lithographic slates of Eichstadt, belonging probably to the families of Æquoridæ and Trachynemidæ, has published, in a recent number of 'Leonhard und Geinitz's Jahrbuch,' a second notice of two other species of Medusæ so well preserved that the family to which they belong can be ascertained beyond doubt. They are from the same locality, and belong to the Discophoræ, to the family of Rhizostemidæ. The restoration which Professor Haeckel has been able to make from the specimens in his possession is quite satisfactory; and the attention of geologists having been called to this subject, we may expect further interesting developments in the history of Acalephæ, since it is now well known that even at the present time a kind of petrifaction of jellyfishes, when thrown upon sandy beaches, readily takes place.—Silliman's *American Journal*, July 1866.

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XLV.—*Outline of a Theory of the Skull and the Skeleton; being an Epitome of a Paper read before the Cambridge Philosophical Society, Feb.* 26, 1866. By Harry G. Seeley, F.G.S., of the Woodwardian Museum in the University of Cambridge.

By a theory of the skull I mean a way of presenting a set of well-known facts so that they explain themselves; for a theory should ever be a continuity of facts.

The value and homology of bones varies so much with the theoretical views used to interpret them, that, with the number of cranial theories on record, it were hard clearly to describe a skull without attempting to co-ordinate the rival views of its structure. Differing in detail, these all affirm, and some attempt to prove, one side or other of the antithesis, that either the skull is a chain of vertebræ or that it no more consists of a series of vertebræ than the vertebral column consists of a series of skulls. There is much to be said in favour of both these views, from every consideration they involve. Every one is familiar with the beautiful way in which Professor Owen brought together brain and brain-case from the whole vertebrate province, till the conviction dawned on his reader that a skull was but another name for the first four of an animal's vertebræ. Nor will Professor Huxley's lucid demonstration be less remembered, reiterated through one vertebrate class after another till we willingly believe, as he would have us, that a skull is a skull—a complex structure, with three segments forming one organ, a brain-case, and two segments forming a face, while sets of bones for special senses close up the eyes and the ears. To the human anatomist considering the human skull it may be a very trivial matter whether he accept one view or the other; but with the comparative anatomist, ever discovering new animals, and often only guided to their true affinities by the skull, different theories give a very different value to arrangements and bones which are

new. And hence, until an attempt is made to discover how far these theories may be different ways of presenting the same truth, and how far they fall short of being true, it will be impossible to compare the facts which they attempt to explain. When one master examines the lowest form of Vertebrate life, the cranium appears to be a continuation of the vertebral column; when another master expounds the highest forms of life, it appears to be a distinct structure, and not to consist of vertebræ. I do not propose to offer anything in this paper which shall be in antagonism with either of these theories.

But it is no less remarkable than patent that, although one Professor has long battled to show that the skull is so many vertebræ, and another Professor battles to show that it is not, no one has discussed the nature of vertebræ, or considered whether it were possible to have a theory of the skull founded in truth before making a theory of a vertebra. In all these speculations a vertebra is regarded as a fundamental principle, as elementary as hydrogen or oxygen to the chemist; and though Professor Owen has classified it into exogenous parts and autogenous parts, no attempt is made to show why it has these parts; and until this is done, I fail to see how it is possible to effect any kind of comparison between a vertebra and a skull; for vertebræ from different animals and from different parts of the same animal vary so much among themselves, that until the principle of the law of variation as well as the law of persistence in structures is known, it will be hard to say whether the elements of vertebræ are or are not modified into skulls, and whether, if so modified, the segments of skulls can in any rational sense be called vertebræ.

Now vertebræ consist of several ossifications, *i. e.* of bones which in various degrees grow. This change and substitution of structure is obviously due to *force*, and must either be of the kind which assists the first development of seeds (in which case it may perhaps at present fitly be called the embryonic or developmental force), or it must be due to the mechanical force of the atmosphere or water, or of one structure or function of the animal modifying another. If it is found, from abstract mechanical principles, that growth *must* take place under the influence of certain mechanical forces, and if it is found, from pathological observation, that growth *does* occur under these influences, then, should it be found in healthy structures that intensity of growth varies with the intensity of the forces, it will be proved that their action is a cause of normal growth. Then it would be possible, from morphology, to show that the same causes which developed the bones originally called them into existence. And therefore, if it is found, in the development of an

animal after birth, that the developmental force and the other forces jointly tend to produce growth in the same direction, which depends on the morphology of the animal, coinciding in results, they will be admitted to be different forms of the same force, originally due to the same cause, namely motion. In this way I shall first try to account for the *growth of bone.*

The forces acting on bones must be from within or from without; and therefore every such force will in its effect be either of the nature of an impact or of an explosion. The forces acting *on* the animal are the media in which it lives (as air and water), the air it breathes and the food it eats; while the mechanical forces acting *within* the animal will be the muscles, vessels, viscera, &c. All these can only produce alternations of pressure and tension and rest. These, therefore, are the stimulants to growth. But growth is an enlargement in which the particles expand and increase externally. And as this cannot be favoured, but rather resisted, by pressure, it becomes evident that the actual increase must take place when the pressure is removed. Therefore, since rest must be purely negative as a force, the stimulant to growth is pressure and tension.

The first and most obvious source of these powers is the muscles; while the more they are used to propel the animal through the resisting air or water, the greater will be the equivalent of general pressure on the bones.

Thus if we take a limb-bone (the humerus, for instance), it will be found most extended in the direction between the radius and the scapula, in which it has to support the weight of the carcase; and if the ends of the bone are examined, where muscles are attached or press tightly, it will be found that growth has extended outward more rapidly than in the body of the shaft, where there is no direct tension, but only a lateral pressure.

But the resistance of the atmosphere produces a different series of modifications. It appears to be a mechanical principle, that if pressure be applied to the outside of a cylinder, it will in effect be relatively equivalent to reducing the pressure within. And it is found, from observations in paralysis and other affections, and in the aged skeleton, that when, from failing vitality, motion is less and the muscles become less powerful (that is, when the pressure is reduced), the bone to some extent dies, and, from the dead part being carried away, becomes smaller and lighter. Now, the effect of motion through the air is relatively to diminish the pressure in the interior of the bones. And therefore it is found, in the sluggish Sloth, that the limb-bones are solid, that the active Mammals have large medullary cavities, while in the more active class of Birds the cavities be-

come larger still. In this class, as in the subclass Saurornia, founded on the Pterodactyles, the process goes on till even the marrow disappears in the bones most used in motion, and their wonderfully thin walls become filled with hot air from the lungs.

Now it becomes necessary to consider in what manner pressure from muscles and other internal forces can act on the bones so as to produce growth; and here I would draw the illustration from pathology. Inflammation, in effect, is pressure; and whenever inflammation extends to the periosteum, that structure is excited to a morbid rapidity of action, and the bone immediately beneath is thickened: hyperostosis is defined to be a thickening and condensation of the shaft from inflammation. Nor is the pathology of the heart and the lung less suggestive where it shows, as is well known, that muscle may be inflamed, indurated, and changed into cartilage, which undergoes a partial change into bone, though, from the nature of the case, the last change can never advance very far, except in the lung, which may be replaced by muscle and well-developed bones.

Therefore, seeing that the effect of motion is a succession of falls, every one of which gives a powerful blow to the bones, and that no muscle can be moved without both pulling and pressing bones, we have an irritating cause, similar in kind though less in degree to that which results in abnormal growth. And accordingly it is found that the greater the activity (that is, the nearer the approach to an inflammatory condition) the more extensive will be the ossification.

Thus in the wild animal, which uses its muscles more vigorously than the tame animal, the ridges and processes for the attachment of muscles are more developed. In the limbs a trochanter appears as a separate ossification, where powerful muscles are attached. The marsupial muscles, which are small in man, become largely developed in the Didelphia, and create the marsupial bones.

Now it remains to show that the intensity of growth depends on the amount of the pressure and tension in the direction of the increase. Dr. Humphrey tells us that bones are densest in those parts which are subject to the greatest mechanical stress, and hardest in those persons who are strongest and most active. Here the intensity of ossification clearly depends on the pressure. And, again, it is observed that bones are most curved in those persons whose muscular strength is greatest—that is to say, where the pressure resulting from muscular action is the greatest; while weak persons, on the contrary, have comparatively straight bones. And thus it is seen that, even in the individual, the form of the bone varies with the relative power

of the muscles. And so when the humerus of an active burrowing animal, like the mole, is compared with a humerus where the limb is merely used as a prop and does not meet with the like lateral resistance, it is found that it is so enormously expanded laterally as to be nearly as broad as it is long, instead of presenting a simple cylindrical shaft. But the best examples will be found in animals which use the limbs differently. Thus in the frogs, which use the hind limbs chiefly in leaping, it is found that they are longer than the fore limbs: this, too, is characteristic of the kangaroo and jerboas, of struthious birds, and of man; nor can an example be cited where an animal uses its hind limbs more than the fore limbs without their attaining to a greater length,—because, as we saw at the outset, to use a limb is to bring to bear on it the pressure of all its muscles and the carcase, which were seen to be the stimulants to growth. Thus, too, birds of powerful flight have the fore limbs developed enormously; while in those which do not fly, and therefore where but little pressure can be brought to the bones, these limbs are extremely small.

Thus it has been attempted to prove by various arguments that pressure and tension is a cause of growth in bones.

To show that the same cause which developes bones originally calls them into existence, it is only necessary to reverse the argument, and show that the less the pressure the less the ossification, until at last, where pressure and tension cease, the bones are lost.

But there are a few simple facts which, exhibiting the formation of osseous particles where they are normally absent, are worth mentioning: one is ossification of the heart, and another the union of fracture in the costal cartilages by bone, just as in birds they become ossified normally; and a third is the significant fact that ossification in the fœtal cartilage first appears around the artery which supplies it—that is, at the first place where pressure can be exhibited. And it seems indisputable that if there had been no inflammatory pressure the heart would never have ossified, and that, but for the pressure of the artery, the fœtal cartilage would not have been converted into bone. This, therefore, I take to be proved; and we shall presently see, when considering the ribs, that pressure is capable of producing not only growth, but new bones also.

It remains now to show that the developmental force (if such a power exist distinct from vitality, of which I see no easy proof) is the same in effect as pressure, and must be regarded as only an inherited result of pressure and tension. Thus Dr. Humphrey tells us that in the fœtal cartilage the curves and processes are already modelled which afterwards characterize

the bones. Now this may either be a result, as by all analogy would seem natural, of the formation of the fœtal muscles which are attached to it, or may be referred to the same force (if such is assumed to exist) which gives the individual his form. But the fœtal cartilage is a minute model of the adult bone. I therefore cannot but conclude that the same forces which developed the adult bone also developed the fœtal cartilage, and that the pressure of the uterus and the tension of the muscular fibres could not have failed to produce the same result at one period of life as similar pressure and tension do at another.

Having thus glanced at the nature of growth in the abstract, as seen in a single ossification, we will now briefly examine the conditions exhibited by the more complex bones, which show several distinct osseous parts. Thus, as is well known, the humerus or femur or the bodies of vertebræ consist, as a rule, of three pieces, each of which ossifies from a distinct centre, and is therefore in that sense a distinct bone. Now, since it has been seen that all ossification takes place under the influence of pressure and tension, we have no other forces at command to which to attribute the formation of these terminal parts called epiphyses.

The turtle shows no epiphyses in its limbs; and in a section of a femur of a young crocodile, kindly made for me by Mr. J. W. Clark, I was unable to distinguish epiphyses; and it is well known that these sluggish animals do not subject the bones to enormous pressure in their crawling motion: but when the activity becomes greater and the pressure is increased, then epiphyses appear, as in the frog, where they long remain separate. And in the case of a limb-bone, it is worth considering that when the limb comes to the ground, it receives a blow at each of its ends, equivalent to the weight it supports, and varying with the power with which the limb strikes the ground. Here, then, it is seen that special pressure, if powerful enough and maintained, developes special ossification, just as the ordinary pressure of the atmosphere, the muscles, and the weight of the body developed the original bone. And hence it is found that in the phalanges, metatarsals, and metacarpals there is commonly but one epiphysis, because, from the way in which the bones are applied to the ground, the pressure takes place at one extremity only.

Moreover there can be no doubt that atmospheric pressure, which holds the bones together so well, must also be a powerful stimulant to ossification.

The ligaments, too, by their resistance all help the epiphysial formation.

And when it is seen that the trochanters appear under the

influence of the muscles, it is obvious that those muscles which are inserted at the extremities of bones must exercise a powerful influence on the formation of epiphyses. Therefore epiphyses and processes are to be looked for wherever the pressure and tension on a bone become more than sufficient to continue ossification. Now just as ossified epiphyses are not to be found in bones where the pressure at the ends is small, so it would be expected that in cases where the pressure and tension of the bone is almost entirely at the ends, and the shaft does not support the animal, the epiphyses should be enormously large, while the shaft would be small. And in Plesiosaurs this is actually found to be the case; for the large limbs, swimming powerfully through the yielding water, have experienced an enormous lateral tension at the ends of the long bones without any greater pressure in the direction of length. And therefore it happens that the ends of the epiphyses which are attached to the shaft become conical and penetrate down the girdling shaft till they meet in the middle of the bone; and, as might be anticipated, that of the distal end is much the larger one. Therefore it would seem possible, if the muscles attached were small, and the bones so placed as only to experience tension and no direct pressure, that the shaft might altogether disappear, and only the two epiphyses remain, as I am inclined to suggest may be the case with the bones which are called tarsal and carpal—a conclusion to which I am led by a consideration of the bones called the tarso-metatarsus in birds, which may be a case in which the tarsus does develope a shaft; and if so, then the metatarsals, like the phalanges, as is usual in the other Sauropsida, will be applied to the ground. There can be no *à priori* reason for supposing that the tarsals and metatarsals should unite together to form one bone; and all the facts of osteology point to their remaining separate; while an erect position for the metatarsal bone in a clawed animal is unusual, and only partial even in *jumping* jerboas, which it characterizes.

The careful dissections of the leg in the ostrich and crocodile &c. by Dr. S. Haughton enable me to add a little evidence from the muscles. The gastrocnemius muscle in the crocodile, as is usual, is inserted in the os calcis (and tarsal bones). It weighed 0·14 oz., while the tibialis anticus and extensor digitorum communis weighed 0·11 oz. But in the ostrich the gastrocnemido-solæus is inserted into the middle of the so-called tarso-metatarsal bone, and weighs 115½ oz., while all the other muscles of the limb and those attached from it to the body only weigh 220 oz., the tibialis anticus and extensor digitorum communis weighing 14 oz. Now there is nothing to induce us to expect that the gastrocnemius would be inserted in the *metatarsal* bone,

as it would be if the tarso-metatarsal explanation were accepted; for, terminating in the Achilles tendon, it is eminently the muscle of the os calcis. And, seeing how the os calcis is elongated by it in ordinary mammals, one cannot be blind to the fact that, if the tension were increased to a power many times as great as it is in mammals, the bone would be extended to a much greater length. And therefore, when there is such a great power as this huge muscle present in birds, capable of elongating the tarsal bones, I fail to see any reason for supposing that the laws of osteological development have been departed from in birds. Therefore, when the muscles become of sufficient power, there is every reason to believe that the tarsal bones will follow the same law as other bones, and become elongated, developing a shaft; and hence, and for reasons indicated, under ordinary circumstances they present the condition of epiphyses of bones where the shafts are never formed.

And all these considerations point alike to the same general conclusion, that one ossification may develope another, if sufficient pressure and tension can be applied to its surface. And this law appears to be equally true for the entire animal as for a single bone. Thus in serpents, where the tension on the vertebræ is enormous, the number of vertebræ increases prodigiously; while in the frog, where progression is so carried on as scarcely to affect the spinal column, the vertebræ are surprisingly few. Among birds, too, where the number of vertebræ is extremely variable, it is found that those genera which use their cervical or sacral regions most, have in those regions most vertebræ: thus the emu and cassowary have each nineteen sacral vertebræ, while the emu has as many in the neck. And while the swan has twenty-three cervical vertebræ, and the average of this region in Natatores, Grallatores, and Cursores is much higher than in the other orders, on the other hand, in birds of great flight the number of vertebræ is small. Such facts appear to lead to the conclusion that the different regions of the body most used experience in consequence a tendency to increase in development.

With these remarks on the relation of structures to functions we may now examine the constitution of the vertebræ.

The body of the vertebra, or centrum, follows the law of a typical bone, and is therefore made up of two epiphyses and a shaft. And when it is seen with what ligaments the vertebræ are connected, to what vibrations they are subject in motion, and what muscles bind them together and pull them about, these powers are the forces which develope and account for the epiphyses.

The rib in a typical animal, as a *Plesiosaurus*, whether called pleurapophysis or hæmapophysis, is extremely short in the neck,

and supported on the lower part of the centrum. In the pectoral region, where the viscera first enlarge, it becomes a little longer, and by the enlargement of the organs has its articulation forced higher up the centrum. In the back, where the viscera are at their maximum, it is found that the ribs are longest, and that they are entirely attached to the neural arches. In the tail these hæmal arches ultimately disappear, and there the vessels dwindle almost to nothing. Here there appears to be an incontestable demonstration that as the internal pressure increases so do the bones lengthen, and so do they give way before it, changing their articular place; and when the pressure becomes reduced in the tail, the arch dwindles to two lateral eminences, and at last is utterly lost. In other words, it is deducible from observation that the development of the ribs depends on the pressure to which the base of the centrum is subjected by the vessels, counteracted, of course, by pressure from the outer muscles and media. This, indeed, we are led to expect from the fact that the ribs are not developed in relation to the same function in animals where the lungs are rudimentary. Thus the frog has *no* ribs. And thus it is found that *caries* of the ribs is often associated with disease of the lungs; while the deformity of the chest called *ectopia cordis* consists in a partial or complete absence of the sternum and ribs with more or less deficiency in the pericardium, pleura, heart, and lungs. In serpents the ribs are functionally innumerable limbs. The rib in many animals terminates at its head in an epiphysis, which articulates with another epiphysis on the neural arch; while at its distal end, in birds, where the tension of the pectoral muscles on the sternum pulls with great power, an epiphysis is ossified and developed to a great length. Thus the rib appears to follow the same general law as other bones; for the distention of the thorax, both by growth and muscles and function in breathing, performs the office of ever-acting muscles, while other muscles, and the skin, and the atmosphere act as a great opposing power.

And in accordance with the same general law which produces the simple ribs, it is found that between their distal ends there is usually developed a common epiphysis, called the sternal arc. In *Plesiosaurus* and animals where the exterior force acting on them was not great, they are arranged one behind another like the rounds of a ladder; but in *Saurornia* and birds, where they came to give attachment to an enormous overgrowth of the pectoral muscles, all are cemented together and modified into a sternum, the greater muscular force having produced a larger amount of ossification. The epiphyses of ribs appear only to be developed when the costal girdle is large and somewhat complete. And therefore, while cervical ribs may well be regarded as epi-

physes of the body of the centrum, dorsal ribs, though the same in origin, assume the appearance of separate bones. And thus to alternations of pressure and tension and rest, growth of all kinds seems to be due.

If the upper arches of the vertebral column are now examined, they will be found united by a much more elaborate system of ligaments than the ribs. There is the posterior common ligament at the base of the arch, the supraspinous ligament above the neural spines, the interspinous ligament, the capsular ligament, and the ligamenta subflava; and hence it is not surprising to find that the neural arches often come close together and underlock each other, and that the neural spines are much more expanded in antero-posterior extent than is generally the case with the ribs. But the neural arches present no correspondence with the ribs in size, remaining small and singularly constant in character. Development shows that they grow upon the first appearance of the film of the nervous column, which growing within and resisted by structures without produces the conditions under which epiphyses are developed. Hence I conclude that the lateral halves of the neural arch are also of the nature of epiphyses. But the neural spine, in those animals where I have had an opportunity of examining it, seems to be quite as fortuitous an element as, and less constant than, the sternal arc. That bone was seen only to be developed under the combined expansive and contractile action of the thorax or an equivalent force; and therefore its homologue is not to be looked for in connexion with an organ of such fixed character as the spinal column. But separated bones for the neural spine unquestionably occur, and seem rather to owe their existence to the spinalis dorsi muscle and the supraspinal ligament.

It has been already remarked that in certain ribs of some animals, as the buffalo and rhinoceros, there are well-marked epiphyses at the ends. Now I conclude from this, that just as these ribs behave themselves like separate bones in this circumstance, so we are justified in believing that, like the centra and limb-bones, they would have produced epiphyses in any other direction if the forces had favoured it; and, indeed, the lateral processes of the ribs of birds may be cited as examples of such a modification. And it is quite possible to explain the formation of the Chelonian carapace by regarding the plates as external epiphysial overgrowths of the vertebral elements. And I suppose that the neural arches do not develope such structures between each other only because, owing to the weakness of attachment to the centrum and the absence of ligaments and muscles of sufficient power, the strain was never great enough to produce active ossification and the vibrating tension in which

the epiphysis takes its origin. But if it were possible that the tension on the neural arches were ever sufficient to produce an impact, then we might reasonably expect that the neural arch itself, like the centrum, should have epiphyses, as, indeed, appears sometimes to be the case between the zygapophyses. And in fishes, where the head is very large and the connexion with the body powerful, there appears sometimes to be such an epiphysis developed, though it is, as perhaps was to be expected, rather an epiphysis of the skull than of the atlas. Thus we are told, by Mr. Robertson and others, that in the carp, for instance, if the bar of bone which bounds the posterior extremity of the exoccipitals be traced from above downwards, distinct traces of sutures will be seen between it and the exoccipitals on which it rests; and following it upwards another suture is found dividing it from the supraoccipitals, so that the bars do not meet above to form a complete arch, the supraoccipitals being prolonged back between these two plates and forming the upper part of this neural arch, which has no centrum of its own, but rests on the basioccipital. Thus it is seen that epiphyses are not limited to the limb-bones and centra of the vertebræ, but that they may be developed on any bone if it is subjected to the requisite tension and pressure.

And from these considerations I deduce the following theory of the vertebra—viz., that it consists of a centrum or centre of ossification which normally developes three (or more) pairs of epiphyses, any of which may assume the appearance of separate bones and develope epiphyses themselves. Thus in the majority of animals there are, 1st, one pair of epiphyses at the front and back ends of the centrum; 2ndly, one pair above, to enclose the neural canal; and, 3rdly, another pair to enclose the viscera. The upper epiphyses are observed to change their position a little with function, while the lower epiphyses may ascend the centrum and become articulated to, and seemingly developed from, the upper epiphyses; all of them may be absent, and the simple original osseous centre will still be accounted a vertebra. But, as we shall hereafter see that the whole skeleton may by this law be accounted for and derived from a single ossification, it would be impossible to admit as a vertebra any structure which varied in plan and function from that which is found in the spinal column.

With this conception of a vertebra it will now be possible to determine what the skull and spinal column have in common, and how far they differ.

Amphioxus lanceolatus appears to demonstrate that in certain vertebrata, where the vertebrate structure is scarcely assumed, a skull need not exist, and that there may be nothing in structure to

distinguish the more anterior or sensory part of the neural column and canal from the part which is always more or less uniform, and is called the spinal column; it also exhibits the fact that a mouth may exist without having the least connexion with the cranium,—thus showing that just as a skull must be a result of functional development of the organs of sense at one end of the nervous column, so by modification the apparatus around the commencement of the digestive canal takes the form of jaws and facial bones. Thus, however close the jaws may be brought in contact with the cranium, and however the primitive cartilages which form the prehensile end of the digestive canal may be modified by adaptation to other ossifications, they constitute a structure which can only owe its development, like everything else, to the higher requirement, or differentiation, of the function in which it took its rise; and so, though forming no part of the original structure of the cranium in the lowest vertebrata, it constitutes by adaptation in higher forms of life an essential part of the skull. And, on the other hand, since the cranium is sometimes wanting (and in *Amphioxus* there is nothing which can be separated from the spinal cord as a brain), it would be hard to regard any brain as more than a functional overgrowth of the end of the spinal cord, and therefore to do otherwise than believe that its osseous case would be originally formed on the same plan with the vertebræ, yet speedily and enormously modified by the different functions which it subserves. Then, just as the brain, from being inseparable from the spinal cord at first, comes at last to be a structure as distinct as may be, there is here a modification not unlike that which separates the segments of a limb (only greater), so that, though both are parts of the same organ, their structure and functions are very different. And therefore, although the covering of the brain may in some organisms be inseparable from the vertebræ, there can only be expected to be the same degree of correspondence between the skull and the vertebral column that there is between the brain and the spinal cord. If a brain has parts which have no representatives in the spinal cord, it will not be surprising if the brain-case has parts which are not found in the case for the spinal cord.

If a skull is examined, it will be found to be the outlet for, or rather the entrance to, the nervous system; this part is occupied by the brain. Secondly, it is the entrance to the digestive system; and this part is constituted by the jaws. And, lastly, it is the entrance of the lungs, respiration being carried on through the nasal apertures. All these several forces of eating, breathing, and observing and thinking exercise great pressure and tension on the regions they affect; and it is precisely these which we have already seen ossifying the skeleton. Seeing how the small epi-

physial elements of the neck in *Plesiosaurus* were observed to put on an enormous and complex development under the increasing pressure of the viscera in the thorax, I cannot but point out that the brain presents to the spinal cord precisely the same sort of relation which the viscera of the thorax do to those of the neck, and therefore to anticipate that the formation of the cranium will follow an analogous law. And it has already been seen how, under the action of the lungs, &c. the ribs elongated and formed epiphyses; and therefore when this force used in breathing comes to be narrowed to a small aperture it accounts for the often osseous condition of the trachea, and, coming in contact with other ossifications, could hardly fail to develope epiphyses: and accordingly we shall see that the nares are generally surrounded by the same set of bones, quite regardless of the place where they open in the skull, whether at the tip of the jaws or near to the brain. And, finally, it would be superfluous to insist on the force manifested in using the jaws; and thus we shall see that the degree of development in the maxillary and premaxillary bones will be entirely proportionate to the pressure and tension allowed by the presence or absence of teeth, and the mode in which the jaws are used.

If an ossified brain-case is examined, it will be seen to be more or less easily divisible into three segments, as, indeed, is generally admitted. The first of these, following Professor Huxley, I take to consist of the basioccipital, the exoccipitals, and the supraoccipital; the second consists of basisphenoid, the alisphenoids, and the parietals; while the third is made up of the presphenoid, orbitosphenoids, and frontals.

As compared with vertebræ, it will be seen, as is remarked by Mr. Robertson and others, that these segments differ in being roofed in by bones (the supraoccipital, parietals, and frontals) to which there is obviously nothing corresponding in the covering of the spinal cord; and they also differ from most vertebræ in the arches touching each other at every point.

Thus, remembering that the brain was originally but the anterior end of the spinal cord, and so far, as evidenced by the law of pressure and tension which has been considered, must have been roofed in by similar structures, we find that when the brain expands in height and size above the proportions of the spinal cord, it becomes roofed in by additional bones, just as the thorax was when it expanded in depth below the limits of the small neck. So that the alisphenoids are epiphyses of the basisphenoid, just as the neurapophyses are epiphyses of an ordinary centrum, and the parietals are epiphyses of the alisphenoids, just as the sternal ribs or sternum in birds, for instance, are epiphyses of the ordinary ribs; and it will hardly

be maintained that the inferior arch of a cervical vertebra of a bird differs less from the inferior arch of a dorsal vertebra than does the ordinary upper arch of a vertebra from the upper arch of a segment of the skull. In the thoracic region the growth and development of viscera is chiefly in depth, as is the weight of the lungs; and in *Amphioxus lanceolatus* the notochord extends anterior to the neural cord, whereas in mammals, even in a very early embryonic state, the neural rudiment which becomes the brain is prolonged far in front of the notochord; and thus it is seen that with its development in height the brain undergoes a development in length, which the thorax did not. And nothing can be more evident than that, restrained by the structures in front and by the vertebræ behind, the growth in length must exercise a pressure and tension in that direction exactly corresponding to the forces which gave rise to the epiphysial bones which roof in the brain as it developes in height. And therefore, since by the influence of such enormous and equable pressure and tension epiphyses are developed in height, exactly the same forces exerted in length cannot but have produced epiphyses at each end; and so, remembering how, up to a certain point, the plan of the brain and the spinal cord must have been the same, it is curious to observe that while the basisphenoid developes the basioccipital and presphenoid for its epiphyses much after the plan of an ordinary centrum, the bones of the neural arch also develope epiphyses in length just as they do in height, as we saw was the case with some fishes—the entire occipital segment answering to the posterior epiphysis, and the entire frontal segment being the anterior epiphysis of the parietal segment of the skull. And accordingly it is found that the elementary bones of these epiphyses converge and close in the brain at both ends, thus demonstrating that they owe their growth to its growth, and extend no further than they are forced by its pressure; and therefore, though the skull will obviously develope quite regardless of the degree of growth in the several parts of the brain, by the simple law of inheritance, yet in many cases the relative size of several bones will be found to vary with the size of the division of the brain which is underneath them. Thus Mr. Robertson remarks that fishes may be divided into a sluggish group, typified by *Lophius*, in which the cerebellum is small, and an active group, in which the cerebellum is large, typified by the *Tunny*; and finds that in skulls of equal length, the occipital segment of the skull measures $4\frac{1}{2}$ inches long in the Tunny, while in *Lophius* it only measures 2 inches: and, ascending in organization, it is seen that as the brain rapidly expands, bones which before, in the lower forms, were quite exterior to the skull become gradually introduced to form part of the cranial walls.

Thus, excluding the sense-bones and dermal bones, I would interpret the neural part of the skull as having been originally developed from a single vertebral centrum and neural arch, following in its development, only in a more perfect way, exactly the same laws as govern the formation of ordinary vertebral arches. That it is a vertebra is not affirmed, because it presents modifications of structure which are nowhere seen in vertebræ; but these, which are the development of epiphyses by a neural arch, are of a kind quite consistent with the vertebrate plan, and certainly to have been expected under the influence of pressure. Indeed it is not too much to say that, under the influence of the requisite pressure, any other neural arch could have similarly been developed into a cranial cavity; and therefore a definition by Professor Huxley, "that the skull no more consists of a chain of vertebræ than the vertebral column consists of a chain of skulls," more faithfully expresses the kind of relation between the neural regions of the two structures than any statement that I have yet met with. And if the neural part of the skull is considered to be a vertebra at all, it can only be an ideal typical vertebra, where every possible part is present, and to which, therefore, the ordinary uniformity of imperfect development of most vertebral arches offers no near parallel. On the whole, the differences and affinities are perhaps so well marked as nearly equally to justify those who would call it part of a skull and those who prefer naming it a transformed and thoughtful vertebra, both of which statements would be equally true.

If the cranium of a full-grown *Gallus domesticus* be boiled, from the great intensity of ossification in the animal, it readily separates into two portions—an anterior part, which is made up of the bones of the face and jaws, and a posterior part, namely the brain-case. And here it is seen that the interorbital septum, which is formed from the trabeculæ, is embraced by the presphenoids and frontals reaching the orbitosphenoids so as to close up the brain as in Mammals; so that the ethmoid presents the relations of a cranial bone, and might be regarded as an ossification produced by the olfactory ganglia—a sort of special epiphysis. The bones which have been considered, it will be remembered, only correspond to the neural arch of a vertebra. Of the inferior arch, or that which corresponds to the ribs, it is at first hard to see any indication. There are under the basisphenoid of most animals two ossifications which Mr. Parker has named basitemporals, which are clearly epiphyses of the basisphenoid. In the subclass of birds called Pterodactyles, these bones are anchylosed to the anterior margin of the basioccipital, and in *Plesiosaurus* they appear to form the inferior

surface of that bone, and to enter into the condyle. But they differ from the inferior epiphyses of vertebræ in being united and never surrounding any vessels; and therefore, perhaps, they are rather to be regarded as distinct ossifications peculiar to the skull.

As we have already remarked, the mouth is the prehensile end of the digestive canal, and in *Amphioxus* it is surrounded by jointed rings of cartilage. And, ascending in organization, it were easy to trace, by way of the lampreys and sharks, the gradual union between the jaws and the skull; and therefore we have to discover the origin and the law which governs the uniformity of development of these bones of the face.

And here I seek the aid of embryology to resolve the bones into their natural groups, though somewhat reluctantly, because the results from one tribe of animals cannot hold quite true for another tribe where the organization differs; but it is so conclusive on the significance of the jaws, that I will give, in a translation of Professor Rathke's own words, his remarks on their origin. He says, "That part of the investing mass of the notochord in which the basisphenoid is developed in many animals, sends out a 'ray' or band downwards on each side, which presents a remarkable similarity to a rib, not only in its mode of origin, but in its original position and form." These, then, it will be seen, are the true epiphyses which correspond to ribs, and, as was to be expected, they grow out of the basisphenoid, which was the original centrum of the skull; and as the true ribs grow down to enclose the posterior part of the digestive organ, so we shall see these ribs grow down to embrace its anterior end, and become modified into prehensile organs. Professor Rathke goes on to say, "But very early there grows out from near the upper end of the ray a long thin process, which passes off at an obtuse angle to it and applies itself to the inferior wall of the future brain-case." Thus the ribs, growing down on the digestive canal, appear to become split, and the upper parts run along the top of it and the lower parts run down the sides, thus eventually coming to embrace the mouth without bringing it in contact with the centrum; but it ought to be remembered that, in the adults of all the animals in which this is observed, union has already taken place between the face and the brain-case.

That the ribs really become split as they apparently do, I do not see any reason for believing, and should rather regard the upper portions of the forks as connate growths produced by causes presently to be considered. The proximal end of the cranial representative of a rib ossifies and becomes the quadrate bone or incus; an intermediate part becomes the os articulare; while the distal end remains unossified, but developes bones on its surface which become the lower jaw.

So far, then, in its general plan the skull follows the vertebral type. But by the narrowing down of the bronchial tube, and the resistance of the surrounding organs, the mouth below and the brain-case behind, a powerful ossifying force, of which we have already seen evidence in the trachea, comes into play, different to that of the chest; for there the digestive canal is *enclosed* by the breathing-apparatus, while here the breathing-canal is small, and nearly shut in by the digestive canal below and by the resisting vertebral centrum above. So that, seeing what the result of the thoracic action was in the development of ribs and in the development of the trachea, it must be anticipated that ossifications will likewise take place in the skull from the same cause in the direction of greatest resistance, *i.e.* above and below the termination of the trachea in the skull; and accordingly we find a triple series of bones above and in front, and another triple series below and behind. The first series consists of the nasal bones, the ethmoid, and the vomer, the nasal bones and vomer being in the position of epiphyses of the ethmoid; and below these are the pterygoid and palatine bones, and an unossified blastemous extension of the latter anteriorly, on which the maxillary and premaxillary bones are developed, just as the prehensile bones of the lower jaw were developed on a cartilaginous extension. This, then, is clearly a distinct region of the skull, to which there is obviously nothing even analogous in a vertebra; and in reviewing its comparative osteology, I find no reason for considering it less a fundamental essential of a developed skull than the neural region itself. And just as the brain-case is known as the neural region, so this part may well be called the bronchial region; for just as the former is a modified neural arch and its centrum, so the latter is a modified termination of the trachea: and thus, although the skull appears in this matter to deviate from our conception of a vertebra as merely an ossified structure, yet it conforms even in that deviation to the plan of a segment of the body, and so brings the skeleton into a closer and more natural unity.

The lower jaw and its upper appendages being a modified rib, we thus exhaust all the vertebral elements without accounting for the maxillary or premaxillary, or the distal elements of the lower jaw exterior to Meckel's cartilage. The maxillaries, by development no less than by function, are the anterior epiphyses of the palatines; while the premaxillaries appear to be the lateral epiphyses of the ethmoid. Such is the circumstance of their origin, though no doubt their development is due to the same pressure by which we have seen that all bones are formed. Thus in the elephant, where the premaxillaries have to support the enormous tusks, they attain an enormous development, covering

the face, extending over the maxillaries, but entering, as in birds and Ichthyosaurs and most animals, into the anterior nares. In ruminants and pachyderms, where the pressure from the teeth is more uniform than in some animals, it is seen that the maxillaries are deep and their upper and lower margins subparallel; and, as though illustrating the community of origin, in some animals the palatines and pterygoids both bear teeth. The bones forming the elements of the oviparous lower jaw I believe to have been developed as epiphyses of Meckel's cartilage by pressure; the dentary element presents the aspect of a terminal epiphysis, and the four other bones a superior and inferior and two lateral epiphyses, which functionally are a diapophysis. And now, of the important elements of the skull, there only remain the eyes and the ears, which correspond, in their relations to the alisphenoid, with the intervertebral nerves. The growth of the eye is a sufficiently evident cause of pressure to account for sclerotic, superorbital, and lachrymal bones; but the periotic bones, which have been so laboriously elaborated by Professor Huxley, appear to me to be nothing but ossifications around the auditory canals which have afterwards grown by contact with other ossifications. The quadrate bone is large when placed between the jaw and the skull, but dwindles to the incus when the pressure is removed; and so the mastoid, squamosal, and petrosal obviously owe their development to their relations with the jaw. They are clearly sense-bones, and therefore, forming no part of the skull except as such, may be here passed over without further notice.

Such, then, is an outline of the mechanical theory of the skull; and such are some of the chief points which I hope to illustrate and demonstrate in the collections of fossil vertebrata which are among the best treasures of the Woodwardian Museum. This theory differs from others in the subordination of structure to function, and the belief that, except for the variation in organization, similar functions will always develope similar structures. It differs from other theories in giving a mechanical reason for the presence of every bone. Its final conclusion is, that the skull is the terminal segment of the body, and that, just as the adjacent segments consist of the pharynx, the larynx, and a vertebra enclosing part of the neural column, so also the skull, which is the termination of these three organs, and where their outlets are visible, must consist of them also; that the brain-case, therefore (the termination of the neural system), is a modified vertebra, that the bronchial circle of nasal and palatine bones is a modification of the trachea, and that the lower jaw is a modified rib developed by the mouth. The respiratory circle of bones is the key to the skull.

XLVI.—*Notes on the Genus* Menobranchus *and its Natural Affinities*. By J. van der Hoeven*.

One of the most important improvements in the natural distribution of Reptiles is undoubtedly the separation, effected by Merrem and F. S. Leuckart in 1820 and 1821, of that class into two groups, named by the former *Pholidota* and *Batrachia*. (Tentamen systematis Amphibiorum, auctore Blasio Merrem, Marburgi, 1820.) The Batrachians have the skin naked, while the Pholidota have the body covered with scales or enveloped in two bucklers (Chelonia). Leuckart, by introducing the appellation Dipnoa for the Batrachians, has seized and made use of a more essential character, viz. the double respiration, the presence of branchiæ at an early stage, or the existence of branchiæ permanently with lungs†. We owe to M. Fitzinger the name *Monopnoa*, corresponding to that proposed by Leuckart, and serving to distinguish the other great division or that of the Pholidota of Merrem ‡.

The researches of various authors have contributed more and more to confirm this primary division. The celebrated physiologist Müller has, above all, by drawing attention to certain anatomical characters which had not been sufficiently regarded, demonstrated the perfectly natural character of these groups §.

There is, in fact, so great a difference between the reptiles of these two divisions that Merrem considered them two distinct classes—an opinion shared by De Blainville. It does not enter into our present purpose to discuss this view; we would, however, remark that the doctrine advanced by a modern author, according to which the Dipnoa should be united with the Fishes, seems to us an exaggeration, and opposed to a truly natural classification.

Among the reptiles with double respiration we must place

* Translated from a separate impression, communicated by the author, from the 'Archives Néerlandaises, tome i. (1866), by Arthur O'Shaughnessy.

† Oken's 'Isis,' 1821, Litterarischer Anzeiger, 257–265: "Einiges über die fischartigen Amphibien."

‡ Neue Classification der Reptilien, von L. J. Fitzinger: Wien, 1826.

§ "Beyträge zur Anatomie und Naturgeschichte der Amphibien," Zeitschrift für Physiologie, herausgegeben von F. Tiedemann, G. R. Treviranus, und L. C. Treviranus, iv. Bd., 2 (1832), p. 190 &c. This remarkable work dates at the commencement of the author's scientific career; he then occupied the chair of Physiology at the University of Bonn. Amongst the anatomical characters of the *Dipnoa* must be cancelled that of the simple auricle formerly attributed to the heart of Batrachians. (See the author's supplementary note, pp. 274–275.) It is, however, especially worthy of remark, as a twofold embryological character, that both *amnios* and *allantois* are here wanting, while they are present in all other reptiles, as well as in birds and mammals.

also a genus left by Cuvier among the Ophidians, but the Batrachian affinities of which had not escaped that illustrious naturalist, and had been remarked already at the commencement of our century by his friend and collaborateur Prof. C. Duméril. This genus, that of the *Cæciliæ,* was placed by Oppel* and Merrem in the subclass which we are dealing with at present. The important discovery of two branchial apertures, one on each side, in a small specimen of *Cæcilia hypocyanea,* made by Müller in 1831, effectually confirmed this view of their affinities, and now consigns the genus to the vicinity of *Amphiuma* and *Siren,* whose movements are effected by dragging the body along the bottom of the waters which they inhabit, and whose very small feet could not be of any assistance for walking.

The Batrachians furnished with extremities have been divided by Duméril into *Anoura* and *Urodela.* The first, of which the frogs and toads of our fauna may serve as examples, will not detain us at present. Suffice it to observe that the external form of these *Anoura* (Batrachians properly so called) departs entirely from that of the *Urodela* (that, for example, of the aquatic Salamanders), and that this difference shows us the slight value due to external form in regard to primary groups in the natural classification of the animal kingdom. We are now far from the time when Linnæus united the salamanders with the crocodiles in his undigested genus *Lacerta*; but it is possible that the vulgar eye and judgment unassisted by science will find this union less strange than that of our actual systems. The frog, with its enormous head, its stunted trunk, and long claws, presents no resemblance whatever to the salamander, and less still to the *Proteus,* while these latter genera would seem to be intimately allied to the lizards, and, above all, to the scincoids.

The scalpel forces us, however, to alter our judgment; and the transitional forms of the frogs during their development prove indisputably that such appearances are deceptive, and that we may not give credence to them without strict examination.

Amongst the Urodela it is well to make a principal division. There are two groups or families of these Batrachians. One comprehends the genus *Salamandra,* i. e. the terrestrial salamanders and the numerous subgenera of the aquatic salamanders or tritons. The other might borrow its name from the genus *Proteus*: such is the family of the Proteidæ or Ichthyoidæ. At the commencement of our century Cuvier published a memoir on some reptiles of this division, which is inserted in the

* Die Ordnungen, Familien und Gattungen der Reptilien, von M. Oppel, (München, 1811, 4to) p. 76. These naked serpents are indicated by the authors above named under the title of *Batrachia apoda.*

"Recueil d'Observations de Zoologie et d'Anatomie comparée" of the Voyage of Humboldt and Bonpland*. The title of this memoir gave occasion to naturalists to make use of the term "doubtful reptiles" to indicate this group. That which was then doubtful is not so, however, at the present day. Doubts there will always be: what field of human research is free from them? but these doubts at present affect other points. That which was then unascertained, and which Cuvier sought to determine, was whether the reptiles with branchiæ were not larvæ destined to lose those organs. He examined the Axolotl, of which Humboldt had given him two specimens which he had brought from Mexico, and he compared it with the Siren of South Carolina and the Proteus of the lakes and subterranean waters of Carniola and Dalmatia. All these animals possessed branchiæ and lungs.

As the result of his researches, Cuvier was convinced that the Siren and the Proteus were adult animals, always retaining the double organs of respiration†, while he regarded the Axolotl as the larval state of some large unknown Salamander‡. Subsequently, however, he placed the Axolotl among the genera with permanent branchiæ, along with *Proteus* and *Siren*§.

To these three species, which form as many genera, we must now add some others, coming, like the Siren and Axolotl, from North America. But, besides these genera with persistent gills, we cannot refuse a place in this natural group for certain animals very similar, but in which we find no gills, although there is a branchial orifice on either side of the neck. A large reptile of this division was already known to Cuvier when he published

* I., Paris, 1811, pp. 93–126: "Recherches anatomiques sur les Reptiles regardés encore comme douteux par les naturalistes, faites à l'occasion de l'Axolotl rapporté par M. de Humboldt du Mexique." This was read at the Institut National, January 19 & 26, 1807.

† Prof. B. Smith Barton had independently arrived at the same conviction.—'Some Account of the *Siren lacertina*' (Philadelphia, 1807), a *brochure* in the form of a letter to J. G. Schneider, and of which only fifty copies were printed, one of which I obtained at the sale of Blumenbach's library.

‡ *Loc. cit.* p. 116. This was still the opinion of Cuvier when he published the first edition of his 'Règne Animal' (1817, ii. p. 101).

§ Règne Animal, 2nd ed. 1827, ii. p. 119, note: "So many persons affirm that it does not lose them, that I feel obliged to acquiesce." However, more recently still, the distinguished American, Spencer Baird, retained similar doubts (Journ. Acad. Nat. Sc. of Philadelphia, Oct. 1849, vol. i. ser. 2. p. 281, "Revision of the North American Tailed Batrachia"). The author expresses himself as follows:—"It is only because there is no positive proof to the contrary that I retain the genus *Siredon* as real, placing it at the bottom of the series. It so much resembles the larva of *Ambystoma punctata*, in both external form and internal structure, that I cannot but believe it to be the larva of some gigantic species of this genus" (p. 292).

his researches on the doubtful reptiles. This is the species to which the inhabitants of the United States of North America apply the name of *Alligator* or *Hell-bender**, while the Delaware Indians call it *Tweeg* or *Tweche*. At the commencement of our century a specimen of this species, from the Leverian Museum, was described by Dr. Shaw under the name of "Leverian Water-Newt"†. An individual of the same species, which the traveller Michaux had obtained on the Alleghany Mountains and presented to the museum of the Jardin des Plantes, was described by Latreille under the name of "Salamandre des monts Alléganis"‡.

It is surprising that, throughout these descriptions, the branchial orifice is not noticed. It is described in the tract of Barton which we have just cited, and is apparent in the figure, otherwise very mediocre, which accompanies the same§. Cuvier speaks of a "cicatrice" on the sides of the neck, in precisely the same position as the gills in *Siren*‖.

All the naturalists who have recognized the two distinct groups of the Urodela have placed the Hell-bender in the same division with the doubtful reptiles. But it is necessary to seek for further characters for this group of Ichthyoids than the persistence of the gills. Such characters are found in the absence of eyelids, in the conformation of the vertebræ (the bodies of

* In a tract by Prof. Barton, printed for his correspondents and friends (Memoir concerning an Animal of the class of Reptilia or Amphibia, which is known in the United States by the names of Alligator and Hell-bender: Philadelphia, 1814), and which I procured from the same source as that on the Siren, we read that the latter name was applied to this animal by the negroes of Virginia, on account of its slow oscillatory motions in its natural habitation the water, and which the slaves thought suggestive of the horrible tortures of the infernal regions.

† General Zool. vol. iii. pt. 1. pp. 303–304 : Lond. 1802.

‡ Hist. Nat. des Reptiles, par Sonnini et Latreille, (Paris, 1802) ii. p. 53, pl. 54. fig. 1; Daudin, Hist. Nat. des Reptiles. tom. viii. (An xi., 1803) pp. 231–232; (Bosc) Nouveau Dictionn. d'Hist. Nat. tom. xx. (An xi.) p. 48. The same lines occur, unaltered, in the last edition, revised and augmented, of this Dictionary, tom. xxx. (Paris, 1819) p. 61; the figure of this species, pl. xii. fig. 1, in tom. xxxi. p. 317, the same as that of Latreille, scarcely deserves reference.

§ This has been copied by Leuckart in his notice of the Ichthyoid Amphibians (Isis, 1821, pl. 5), who adds another and much worse figure, taken from a specimen stuffed with straw (!) in the Museum of Vienna. We owe a better figure to J. R. Peale, appended to the observations on the Salamander genus by Dr. Harlan (Annals of the New York Lyceum of Nat. Hist. 1825, vol. i. pl. xvii. p. 234). This figure has been copied in the English remodelled and augmented edition of the 'Règne Animal' by Griffith (1831, vol. ix. p. 475). I would also crave permission to cite that published by me in the 'Tijdschrift voor Natuurlijke Geschiedenis en Physiologie,' 1838, iv. pl. 5 B. fig. 7.

‖ Recherches, *l. c.* p. 101.

which are concave at both ends, as in fishes), in the cartilaginous condition of the pieces forming the carpus and tarsus, and probably also in the extraordinary size of the blood-corpuscles (remarked in the first instance in the Proteus, but since then found to prevail in all species the blood of which has been subjected to microscopical examination). In 1821 a new genus was added to the division of the Proteidæ. It is a North-American genus, the elongated form of which has a certain resemblance to that of the Proteus, and which also possesses four feet, but even smaller than those of the Proteus. Without these indications of four extremities, the genus would present strong affinities with *Siren*. But that which above all distinguishes it both from *Proteus* and *Siren* is the fact of its not possessing gills, but having a branchial aperture on each side of the neck. This genus has been designated by the name *Amphiuma**.

Our knowledge of the Proteidæ had arrived at this point, when Müller took upon himself to unite this new genus, under the name of *Derotreta*, in a subdivision with the Hell-bender†. This union was an artificial one; for all that was then known relative to the genus *Amphiuma* tended to secure it a place in the vicinity of *Siren*. The Hell-bender, named successively *Abranchus*, *Menopoma*, and *Cryptobranchus*, was imperfectly known as regarded its internal structure. Moreover the cranium, of which Cuvier had given an exact figure, presented only remote relations with that of the *Amphiuma*‡. A large reptile from Japan, the knowledge of which we owe to the zeal of M. de Siebold, who succeeded in bringing over a living specimen §, appearing to me to show a strong affinity with the Hell-bender of North America, I felt driven to regard the former, *not as a species of a new genus*, but as a new species of a genus long known. Instead of proposing a new generic denomination, I

* It is worthy of note that this genus was really discovered before the Hell-bender or Great Salamander of Michaux, by the same Dr. Alexander Garden who made known the Siren. He sent this animal to Linnæus in 1771, under the name of *Amphiuma*. "These documents remained among the papers of Linnæus, and were never brought to light but through the edition published in 1821, by Sir James Edward Smith, of the Correspondence of the great Swedish naturalist." (Cuvier, "Sur le genre de Reptiles batrachiens nommé *Amphiuma*, et sur une nouvelle espèce de ce genre, Mémoire lu à l'Acad. des Sc. Nov. 13, 1826," Mém. du Muséum, 1827, tome xiv. p. 2).

† *Derotremata*, Müller, Zeitschr. f. Physiol. iv. p. 203.

‡ Müller, who knew these skulls only through the figures of Cuvier, himself made a similar remark (*loc. cit.* p. 204). The hyoid has been figured by Harlan, *l. c.*

§ This reptile is still living in Holland, and has been for many years in the rich zoological garden of Amsterdam. Several other zoological gardens now possess specimens.

thought it more proper to use the name *Cryptobranchus,* proposed for the Hell-bender by Leuckart in 1821*.

It seems to me beyond doubt that, even if we demur to this union, the two species in question cannot be referred to two different families. As soon as we unite them, we must renounce the distinction of the *Derotreta.* I would defer to the judgment expressed in so clear and decided a manner by Prof. Hyrtl in his 'Schediasma anatomicum'†.

In order to place this gigantic Batrachian in the family of the Proteidæ or ichthyoid Urodela, it would be necessary to strike out from among the characters of that division that of the possession of permanent branchiæ or branchial fissures. The genera are not numerous enough to render advisable a further division. But there would still remain to be determined the actual disposition to be given to these genera in order that their various relations might be clearly set forth according to the several degrees of their reciprocal affinity. I entered upon this question more than thirty years ago, when engaged upon the class of Reptiles in connexion with the second edition of my 'Manual of Zoology.' I considered it a second time when opportunity was offered me for studying two specimens of *Menobranchus* through the liberality of the Smithsonian Institution of Washington.

I have not as yet spoken of this genus, which deserves a distinct place in the family which we are engaged upon at present. It was constituted under its present name by Harlan, who at

* Oken's 'Isis,' *l. c.* The name *Menopoma* was proposed by Harlan, who had previously given the name *Abranchus* to this genus, which he fancied was "destitute of branchiæ at all periods of its existence" (p. 233). This notion, contrary to all probability, has been refuted by facts. Mayer, formerly Professor of Anatomy at Bonn, found branchial tufts, which, however, were already on the eve of disappearing, in a specimen of 4 inches 6 lines, obtained through the Prince de Wied. (Analecten für vergleichende Anatomie, von Dr. A. F. C. J. Mayer: Bonn, 1835, p. 95.) It would seem that the name *Menopoma* owes its origin to the persistence of an operculum, *i. e.* of a prolongation of the skin extending over the aperture on the sides of the neck (from *μένειν, to remain,* and *πῶμα, operculum*). As there is not any operculum properly so called, I think that the name *Cryptobranchus* deserves to be retained, and that there is no necessity for introducing a new name. *Tritomegas,* proposed by the authors of the 'Erpétologie générale' (Duméril et Bibron, 1854, ix. p. 153), even though its actual composition were better than it is, would be inadmissible, as having been previously employed, though according to a very different etymology, for a genus of Hemiptera (Hist. Nat. des Insectes Hémiptères, by C. J. B. Amyot and Audinet-Serville: Paris, 1843, p. 98).

† *Cryptobranchus japonicus,* 'Schediasma anatomicum,' Vindobonæ, 1865, 4to, p. 4. "Cum *Menopomate* affinitas tanto argumentorum pondere vindicata fuit, ut nullæ amplius circa hanc quæstionem lites moveri possint."

the same time designated by the name *Abranchus* the genus which we now call *Cryptobranchus**. As its name implies, the *Menobranchus* presents a character afforded also by the Proteus and Siren, viz. that of the persistence of the branchiæ. It has, in common with the Proteus, another character which distinguishes it from the Siren, viz. the possession of four feet. It was on this account that Lacépède, who, in 1807, published a description, accompanied by an indifferent figure, of a specimen of this species, thought proper to give it the name of *Protée tétradactyle*, adding, however, that in case it should turn out to be a larva destined to lose the branchiæ, it might be called *Salamandre tétradactyle*†. This creature has four toes on the hind feet, while the Salamanders have five; now, however, we know of some species of Salamanders which also have four toes on all the feet‡.

The origin of the specimen in the Paris Museum was uncertain: Lacépède knew only that it had been received from a naturalist of Bordeaux. However, the notice published by Lacépède did not give the first description of this doubtful reptile. The learned naturalist J. G. Schneider had most certainly seen a specimen of the same species in the cabinet of Hellwig at Brunswick, which specimen the latter had received from North America (Lake Champlain). As the description given of this by Schneider is both concise and at the same time sufficiently explicit, it will perhaps be worth while to insert it entire, in a note §.

* Annals of the New York Lyceum, i. p. 233. It had, however, been previously named *Necturus* by Rafinesque (Blainville, Journ. de Physique, tom. lxxxviii. p. 418). Those who would restore the earlier names of genera should consequently adopt this name of *Necturus*, unless, indeed, they would prefer that of *Sirena*, which we find applied to the same reptile by this very Rafinesque, in 1818 (Amer. Monthly Mag. iv. p. 41). I know this journal only through the citation of Mr. Spencer Baird (Journ. Acad. Nat. Sc. of Philadelphia, 1849, i.).

† "Sur une espèce quadrupède ovipare non encore décrite," Annales du Muséum d'Hist. Nat. x. (1807) pp. 230–233, pl. 17.

‡ These species form the genera of aquatic Salamanders—*Salamandrina*, Fitzinger, and *Hemidactylum*, Tschudi, or *Desmodactylus* of Duméril and Bibron. See the 'Erpétologie générale,' tome ix. pp. 68 & 117–120.

§ This description dates from 1799, and seems to be the earliest notice we possess relative to the *Menobranchus*. "Corpus ultra 8 pollices longum et fere pollicem crassum, molle, spongiosum, multis poris pervium, in utroque latere tribus macularum rotundarum nigrarum seriebus variegatum; cauda compressa et anceps, utrinque maculata, inferiore acie recta, superiore curvata, in finem teretiusculum terminatur. Caput latum et planum; oculi parvi; nares anteriores in margine labii superioris; maxillæ superioris geminæ ut inferioris dentes conici, obtusi, satis longi; lingua lata, integra, anterius soluta; apertura oris patet usque ad oculorum lineam verticalem; labia piscium labiis similia. Pedes dissiti, quatuor, tetradactyli

A figure much more characteristic than that of Lacépède has been given by the naturalist Harlan, in the first volume of the 'Annals of the New York Lyceum' already cited (pl. 16, *Menobranchus lateralis**).

Fitzinger, without adding anything to our knowledge of the genus, gave it the new name of *Phanerobranchus* instead of *Menobranchus*.

There can be no doubt that the first impression made by a comparison of the *Menobranchus* with the Hell-bender is that the two animals have a very great resemblance, and that it is almost solely by the presence of the branchial tufts and the tetradactyle hind feet that the *Menobranchus* is distinguishable from the *Cryptobranchus* of the Alleghanies or from that of Japan. Without having the enormous bulk of these two reptiles, the *Menobranchus* is yet a very large species as compared with the Tritons and Salamanders, and attains the length of fourteen inches†.

If we except the character of the branchial tufts and the lateral fissures on the neck, we may arrange all these doubtful reptiles in two groups,—one of which, by its elongated and cylindrical form, approaches the Siren; the other, by its more depressed and much shorter body, more nearly resembles the Salamander. It was this method that I adopted in my Manual. The "Anguiform" subdivision contains the genera *Siren*, *Hypochthoa* (or *Proteus*), and *Amphiuma*; while that of the Cordylini ‡ embraces the genera *Menobranchus*, *Cryptobranchus*, and *Siredon* (Axolotl). However, as the result of my subsequent examination of *Meno-*

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omnes, absque unguiculis. Ani rima in longitudinem patet. Branchiæ utrinque ternæ extus propendent, appositæ superne totidem arcubus cartilagineis, quorum latus internum tubercula cartilaginea, veluti in piscium genere, exasperant. Branchialis apertura gemina utrinque adest tantum; infimus enim et supremus arcus branchiarum cuti adnatus est." (Historiæ Amphibiorum naturalis et litterariæ Fasciculus primus, Jenæ 1799, 8vo, pp. 50–51.) Cuvier was acquainted with this description, and speaks of it in connexion with the Axolotl, to which he seemed rather inclined to apply it, supposing that some error had arisen as to the number of the toes. It is astonishing that, although attached to the same establishment, and residing in the Jardin des Plantes, Cuvier was ignorant of the existence of the animal which Lacépède described almost about the same time.

* Copied in Griffith's 'Animal Kingdom,' Rept. p. 476.

† Lacépède's specimen was only 150 millimètres; but the smallest of the two which I have received measures more than double that, and the other one 362 millims. The best figure of this great Batrachian which I am acquainted with is that published last year by Prince Maximilian of Neuwied in the 'Nova Acta Acad. Cæsar. Leopoldino-Carolinæ,' tom. xxxii. 1. tab. 7.

‡ "We may apply to the larvæ of the Salamanders the name of 'cordyles,' which, according to M. Schneider's remark, they bore among the Greeks." (Cuv. Rech. sur les Rept. dout. p. 93.)

branchus, I became convinced that this genus is much more intimately connected with *Proteus* than with *Cryptobranchus*. I would again repeat that appearances in these matters are extremely deceptive, and that they are by no means to be depended on in a natural system of classification. Such a system should be the result of serious study and conscientious investigation.

I may hereafter give publicity to some results of my examination of *Menobranchus*—an examination undertaken, in the first instance, solely with a view to my own instruction. It is to be hoped that Dr. Fischer, of Hamburg, will soon bring out the continuation of his researches on the anatomy of the doubtful Reptiles*.

Some details relative to the anatomy of *Menobranchus* are to be found in Mayer's 'Analecten für vergl. Anatomie,' Bonn, 1835, 4to, pp. 82, 85, together with figures of the skull, brain, and organs of generation of the male. This latter figure hardly corresponds with my own actual observation. M. Gegenbaur has given a description and figure of the carpus and tarsus as well as of the claviculo-scapular apparatus in the *Menobranchus*. (Untersuchungen zur vergl. Anatomie, I. Heft. Carpus und Tarsus: Leipzig, 1864; II. Heft. Schultergürtel der Wirbelthiere: 1865.)

Meanwhile I will be content to notice that the skull and the hyoid apparatus, the conformation of the bones or cartilages of the shoulder, the disposition of the viscera, the form of the lungs, and the structure of the organs of generation appear to indicate that the subterranean and, so to speak, atrophied *Proteus* of Europe† finds its representative in a robuster and larger creature which inhabits the lakes of the United States. It is, however, proper to remark that the number of the vertebræ is greater in *Proteus*, which thus more nearly approaches the *Siren*; while the attachment of the pelvis at the thirtieth or thirty-first vertebra in *Proteus* shows a still greater departure from the *Menobranchus*, in which the pelvis is attached to the eighteenth or nineteenth vertebra, as in the *Cryptobranchus Alleghaniensis*: this latter condition differs but little from that found in the Japan species, in which the pelvis adheres to the twentieth or twenty-first vertebra‡, and in the Axolotl and Tritons, in

* Anatomische Abhandlungen über Perennibranchiaten und Derotremen, von Dr. J. G. Fischer. Erstes Heft. Hamburg, 1864.

† "Il [M. Schreiber] ajoute qu'il est plutôt porté à regarder les Protées comme des espèces d'*albinos* ou de *crétins*, que comme des larves; mais il faudra toujours convenir que ce ne peuvent pas être des *albinos* d'espèces connues, puisque leur ostéologie n'a rien de commun, pour le nombre et la forme des pièces, avec celle d'aucun autre reptile." (Cuv. Rech. sur les Reptiles douteux, p. 123.)

‡ In the specimen of the Japan *Cryptobranchus* dissected some years

which there are sixteen or seventeen vertebræ between the skull and the pelvis.

We must therefore guard against expressing this relation too strongly; and, while asserting that the nearest affinity of the *Menobranchus* is probably with *Proteus,* we must, at the same time, admit it as intermediate between this and *Cryptobranchus.* I should incline even to regard *Menobranchus* as occupying the central position in the ichthyoid group. In fine, we have in the present only another instance of what nearly always occurs in families and groups composed of but few species, and these spread over various and remote countries: there are almost as many genera as species; and, in spite of the common bond of affinity, there is a very marked difference in the general form and in the proportions of the body and its parts.

Those who would prefer to dispose the genera in a single series, might perhaps do so by allowing *Siren* to follow *Cæcilia,* and the Axolotl to occupy a corresponding position on the other side leading to the Salamanders (Urodela with eyelids). The ichthyoids afford a very interesting illustration of the proposition that some animals present as permanent a form which is only transitory in others; and Lamarck might have said that, in the Axolotl, nature was on the point of forming the Triton. Cuvier already in 1807 made use of the happy expression *larve permanente*; and it was in accordance with this that he said that the Siren might be regarded as a permanent larva of this family*.

We should thus have the following succession:—

Siren,
Amphiuma†,
Proteus,
Menobranchus,
Cryptobranchus,
Sirenodon,

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since at Rotterdam, the pelvis was found to be suspended, on the right, from the twentieth, and on the left from the twenty-first vertebra. (Aanteekningen over de Anatomie van den *Cryptobranchus japonicus,* door Dr. F. J. J. Schmidt, Dr. Q. J. Goddard en Dr. J. van der Hoeven, Jun.: Haarlem, 1862, 4to, p. 11.) The authors of this memoir cite an observation of C. A. Schultze, attesting a similar inequality or asymmetry as observed in the skeleton of a *Triton cristatus.* They might also have added that the anatomist Mayer had recorded a like circumstance with regard to the other species of *Cryptobranchus,* that from the Alleghanies. Although it would seem to be normal in this species that the pelvis be thus suspended from the twentieth vertebra, Mayer observed, in one of the skeletons prepared by him, that it adhered only on the left side to this vertebra, but on the right to the nineteenth (Analecten, &c. p. 78).

* Recherches sur les Reptiles douteux, p. 109.

† These two genera depart more particularly from the true Salamanders

a succession which I believe to be sufficiently natural, although, strictly speaking, every arrangement in a single series is defective.

Finally, since the anatomical materials respecting the genera of North America are very much dispersed (being contained partly in journals and memoirs of societies and academies not always to be found in the very largest of public libraries), it would be very desirable to have collected together all that has been published upon these doubtful reptiles of America. There would then remain another undertaking, viz. to arrange in a systematic form all that we now know concerning the various forms of this small group*; and this, though a work of compilation, could be executed only by an able naturalist.

The labours of Rusconi with reference to the *Proteus* are well known; but, as regards the other genera, the *Cryptobranchus* of Japan is almost the only one of which we have any complete anatomical details, viz. those which we obtain through the researches of the three physicians of Rotterdam, published by the Société Hollandaise, and from the admirable work of one of the greatest anatomists of our time, Professor Hyrtl of Vienna.

It is to be lamented that there still reigns some confusion throughout much of what has been published respecting these doubtful reptiles, and even in works of well-merited celebrity. It is stated in the 'Erpétologie générale' that I have figured the nuchal fissure in the *Cryptobranchus* of Japan†, whereas the entire plate, and consequently also the figure cited, refers to the North-American species. The work of Duméril and Bibron having certainly a much more extended publicity than my Dutch memoir‡, I have thought it advisable not to neglect the present occasion to remove this error, and the more so since I

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by the great number of their vertebræ. Cuvier counted 86 vertebræ in the *Siren*, 99 in *Amphiuma tridactyla*, and 112 in *Amphiuma didactyla* (Mém. du Muséum, xiv. p. 8).

* Unless we suppose that the genus *Proteus* contains several species (Fitzinger, "Ueber den *Proteus anguineus* der Autoren," Sitzungsberichte der mathem.-naturw. Klasse der Kaiserl. Akad. der Wissenchaften, October 1850), the entire group numbers scarcely ten species. I know not what to think of the eight species of *Necturus* which Rafinesque affirms to exist in the United States (Journal de Physique, lxxxviii. p. 418); but they have not been noticed by those who have written about the fauna of North America since his time.

† "Il n'y aurait donc de différence que dans l'absence du trou collaire que M. van der Hoeven a figuré pl. 2. fig. 8," &c. (ix. p. 164).

‡ I regret extremely that Prof. Duméril, the venerable veteran who honoured me with his friendship, did not consult my "Fragments zoologiques," in the third volume of the 'Mémoires de la Société de Strasbourg' (1840), where my memoir on the Pseudosalamander, the great Japan reptile, is translated entire.

myself have insisted strongly upon this very difference between two species which otherwise present so many points of reciprocal relation. We would also remove a confusion which exists relative to the reptile in the Museum of Hellwig, described by Schneider. We have cited this reptile as a *Menobranchus*; and the authors of the 'Erpétologie' give it also among the synonyms of *Menobranchus lateralis* (p. 184); but they have at the same time translated Schneider's description into French and applied it in the case of *Siredon Harlanii*, affirming that it accords perfectly with this latter (p. 181). In order that it might do so, however, the authors of the 'Erpétologie' have added to the account of the feet (tetradactyli omnes) the words "les pattes postérieures en ont cinq." There is no reason whatever for accrediting Schneider with this error; and in any case his description should not be cited for two different species: it applies properly to *Menobranchus* without any such modification.

It is perhaps not inadmissible to terminate a notice of the doubtful reptiles by a speculation. There is a species of Batrachian from California, known to me only through the figure and description in the Zoological Atlas* of Prof. Eschscholtz, and which that author has named *Triton ensatus*.

This species has been referred to the *Salamandra Jeffersoniana* of Green, of which Tschudi has constituted the genus *Xiphonura*. Such, however, is not the opinion of one author, who is well acquainted with these species from the United States of America, Mr. Spencer Baird, and who does not place this figure of Eschscholtz among the synonyms of his *Ambystoma Jeffersoniana* (p. 283), but refers to *Triton ensatus* among the species which are doubtful or known only through the descriptions of authors. It is very desirable that this Californian species should receive further examination. Its dimensions of 11½ inches would lead us to suppose that it belongs to the group we are at present engaged upon; and its skull, figured in the Atlas of Eschscholtz and described by Rathke, presents (as this latter author has already remarked) many points of relation to the *Cryptobranchus* of the Alleghanies. It is to be lamented that the eyes were ill preserved, and that the description does not inform us whether they were furnished with lids or not. I am almost inclined to suppose that eyelids did not exist, but on this point I feel a certain amount of doubt. In fine, I should be in no way astonished were this animal, when better known, to call for the establishment of a new genus, akin to *Cryptobranchus*.

* Zoologischer Atlas: Abbildungen und Beschreibungen neuer Thierarten während des Flott-Capitains von Kotzebue zweiter Reise um die Welt beobachtet von Dr. F. Eschscholtz, 5tes Heft. Berlin, 1833.

The following is a synoptical table of the genera of the family *Proteidæ* :—

Feet four or only two anterior ones. Eyes small, and without lids. Vertebræ biconcave.

Body	much elongated, cylindrical; feet very small. Feet	two; branchiæ persistent......	*Siren.*
		four; no persistent branchiæ; two nuchal fissures	*Amphiuma.*
		four; branchiæ persistent ...	*Proteus.*
	moderately elongated, more or less depressed. Feet four. *Branchiæ*	persistent throughout life; four toes on all the feet	*Menobranchus.*
		persistent throughout life, in the form of long tufts; four toes on fore feet, five on hind feet	*Sirenodon.*
		in early stages only; four toes on fore feet, five on hind feet............................	*Cryptobranchus.*

XLVII.—*On some new Species of Fossil* Volutes *from the Tertiary Beds near Melbourne.* By FREDERICK M'COY, Professor of Natural Science in the Melbourne University, Government Palæontologist to the Geological Survey, &c.

FIGURES of the following species, collected by the Geological Survey under Mr. Selwyn, will shortly appear in the Decades I am preparing on the recent and fossil zoology of Victoria. As, for some years, I have prepared descriptions of nearly all the known fossils of the colony, I have been pressed to send descriptions of the more remarkable forms to the 'Annals' for preliminary publication.

Voluta macroptera (M'Coy).

Shell fusiform until nearly adult, when the outer lip becomes dilated into a very large, thin-edged, triangular, flattened wing, the outer margin of which is slightly convex, the posterior margin concave, running up halfway to the suture of the penultimate whorl in a slight channel; the approximately rectangular junction of the outer and posterior margins broadly rounded. Apical angle about 55° in middle-aged specimens, and 35° in young ones 1½ inch long. Spire with a concave outline of four rapidly enlarging whorls and a mammillary cap-shaped pullus of one and a half turn, the basal halfturn of the pullus less than half the width of the next succeeding turn of the spire, the remain-

ing turn nipple-shaped, with a small eccentric projecting apex; the length of the pullus equalling once and a half the width of the next following turn of the spire. Each turn of the spire embracing the next preceding one at the suture, near which they are concave, then forming a convex shoulder and nearly parallel with the axis of the shell below; body-whorl fusiformly narrowed in front, and marked with a broad siphonal notch, without anterior crest or ridge. Inner lip excessively thin, moderately spreading; plaits of the columella four, widely separated, very prominent, narrow, one smaller. Aperture moderately wide, oblong, narrowed above and below, becoming effuse with age.

Pullus smooth; the next two turns of the spire with excessively fine spiral striæ, only visible with the lens (about ten or eleven in the space of 1 line); rest of the spire and body-whorl smooth or marked with fine lines of growth. Length of pullus 4 lines, width of ditto 3 lines; length of adult (including the pullus, which is 3 lines) 6 inches; proportional length of body-whorl $\frac{45}{100}$; length of wing $\frac{92}{100}$; width of body and wing $\frac{70}{100}$; width of body on inside of base of aperture $\frac{38}{100}$.

There is no living or fossil species at all like the present in the large, thin, angular, wing-shaped outer lip and fusiform body. Young specimens an inch and a half long are irregularly fusiform, of two whorls in addition to the pullus of nearly two.

The layer of shell bearing the microscopic spiral striæ seems very liable to fall off, leaving the whorls only marked by the lines of growth.

Not uncommon in the passage-beds of the tertiary sands, Ad. 22, at Bird Rock, near Geelong.

Voluta Hannafordi (M'Coy).

***Fasciolaria Hannafordi*, olim, MS.**

Broad, fusiform; pullus at apex of spire, very large, smooth, spheroidal, of little more than one turn and a quarter; spire conical, apical angle 70°, of four whorls (besides the pullus), each obtusely angulated in the middle and bearing on the angle from twelve to seventeen large nodose tubercles, obtuse and conoidal on the body-whorl, on which the smaller number is found, more elongate on those of the spire, on the upper of which the greater number occur; the oblique space between the tubercles and the suture marked with narrow, slightly undulating, thread-like, spiral ridges, irregularly alternating in thickness; below the tubercles the body-whorl is smooth or marked with obtuse lines of growth as far as the anterior extremity, which is marked by thick obtuse spiral striæ crossing the lines of growth; but the young whorls or vertical portions of the smaller turns of the spire are marked with spiral striæ slightly larger and less

distinct than those of the posterior portion; and, finally, in very large old specimens, the spiral striæ on the space above the tubercles are reduced to a few near the suture. Outer lip in adults greatly dilated into an oblong wing, with a broadly rounded auriculate posterior margin rising up for attachment nearly to the suture of the penultimate whorl; outer margin nearly straight, thin, and slightly inflected, ending at the narrowed end with three large, equal, very prominent, compressed, widely separated, oblique plaits, besides which, in some examples, are one or two closer and smaller ones (usually absent); aperture moderately large, oblong.

Length of small perfect specimen 6 inches, proportionate length of body-whorl $\frac{72}{100}$, of penultimate whorl $\frac{13}{100}$, antepenultimate whorl $\frac{9}{100}$, preceding whorl $\frac{4}{100}$; length of pullus $\frac{3}{100}$, diameter of pullus $\frac{10}{100}$; diameter of succeeding whorl at suture $\frac{8}{100}$; length of wing $\frac{90}{100}$; greatest width of body-whorl and wing $\frac{65}{100}$, of penultimate whorl $\frac{32}{100}$; ordinary length of pullus 6 lines, diameter 7 lines.

So disproportionately large and smooth does the pullus or young nucleus on the top of the spire appear, that it looks like a comparatively large *Natica* or *Helix* artificially stuck on the comparatively slender, regularly nodulated, and striated spire, its disproportion far exceeding the greatest living instance of such an incongruity, the recent *Voluta mamilla.* The first very large specimen seen was presented by Mr. Hannaford, of Warnambool, an enthusiastic naturalist, after whom I have great pleasure in naming the species. This specimen, having the apex absent and the outer lip and the anterior end of the columella broken off, as well as possessing two unusual small plaits behind the others, looked so much more like a *Fasciolaria* than a *Voluta*, that in my manuscript I used the former generic name, until I saw other specimens showing the true characters of the notched anterior end, mammillary spire, &c.

There is no known recent or fossil species at all approaching it in general characters.

Rare in Tertiary clays of Muddy Creek, near junction of Grange Burn, five miles from Hamilton.

One very imperfect specimen, presented by Mr. Hannaford, from the clays of Port Fairy, Warnambool, where it occurs with several other species of the Mount Eliza beds. Rather rare in the clays near the foot of Mount Eliza, in Hobson's Bay, whence the perfect specimen was obtained, as well as a few fragments of the spire with the large nucleus attached. Rare in clays of the Orphan Asylum Reserve, Fyan's Ford, Ad. 28; rare in clays near Mount Martha.

Voluta antiscalaris (M'Coy).

Ovate, moderately ventricose, rather abruptly attenuated towards the front; spire moderately acute, apical angle 65° to 70°, of four to five whorls, and a rounded, swollen, smooth, oblique nucleus at the tip, of one turn and a half; body-whorl with about sixteen to twenty-four angular, slightly sigmoid longitudinal ribs extending rather less than halfway to the front, narrow and sharp in the young, wider and more obtusely angular in adults, becoming gradually obsolete in front, each ending in a sharp conical tubercle crowning the obtusely angulated shoulder; a second row of smaller, pointed, conical tubercles surmounts the larger on each whorl; the space between the two rows is deeply concave and rather wider than the interval between the corresponding larger tubercles; the space between the upper row and the suture is flattened, nearly horizontal, and about half as wide as the space between the two rows, both spaces marked only by the coarse lines of growth; whorls, anterior to the tubercles, crossed by deep, narrow, spiral sulci having flat spaces between them about equal to half the distance of the longitudinal ribs from each other; usually about three of these spiral striæ visible on each of the whorls of the spire, crossing the longitudinal ridges. Pillar-folds slender, widely separated, oblique, three or four, the third (or fourth, where it exists) posterior, abruptly smaller than the two anterior plaits; outer lip thin, smooth. Length of large specimens 2 inches; length of body-whorl $\frac{73}{100}$, penultimate whorl $\frac{15}{100}$; greatest width $\frac{45}{100}$ to $\frac{50}{100}$. A specimen 8 lines long gives all the same proportional measurements.

A careful comparison of specimens of the true *V. scalaris* (Sow.), from the Middle Eocene beds of the Isle of Wight and Barton, will show (what none of the existing figures or descriptions would) that our species, which I have named *V. antiscalaris*, is not identical, but a most remarkable instance of a representative form, distinguished with apparent doubtfulness by a slightly longer spire, less ventricose body, and the ribs less twisted at their anterior end, but with perfect certainty by the spire, which in the European species is sharply pointed (in accordance with the genus *Volutilites*, Swa.) and of eight or nine gradually and regularly tapering whorls, the apical two or three smooth; while in the Victorian species it terminates in an obtusely rounded, smooth, swollen nucleus or "pullus" of one turn and a half, below which are only five sculptured whorls in adult individuals. In accordance with the slightly more slender form, the pillar is less curved than in the English species, and the plaits slightly thinner and more oblique; the number of ribs in a whorl is greater (being about fourteen or fifteen in the English species);

but in all other characters the coincidence or representation of characters is so complete that, if the tip of the spire were in each case absent, the nicest eye could scarcely separate them; yet the distinguishing character is one of such importance, and so invariable, that there can be no doubt of its marking a perfectly distinct species.

This species is also closely allied to the *V. nodosa* (Sow.) of the Hampshire Eocene Tertiary, Barton Clay, and Bracklesham beds, but may be distinguished by the upper row of tubercles of the spiral whorls being distinctly separated from the suture by a space equalling about half the width of the space between the upper and lower rows of tubercles on each whorl, as in *V. scalaris*: one or two very old thick specimens show a spreading inner lip, and a very faint indication in some lights of a crenulation on the edge of the outer lip; and the plaits are thickened, and in one case an intermediate fifth plait appears.

Common in the Tertiary clays of (Ad. 14) parish Moolap; a variety not uncommon in Tertiary clays of Orphan Asylum Reserve, Fyan's Ford, Ad. 28, not uncommon in blue clays and limestone near Mount Martha. Var. *α. levior* has the apical angle 65° to 70°, often a fourth small columellar fold, and the spiral transverse sulci become nearly or quite obsolete near the spinous shoulder, and sometimes over more than half of the body-whorl as well as on the whorls of the spire; it is also a little stronger, but is certainly only a variety. In clays and limestone, Mount Martha.

Voluta anticingulata (M'Coy).

Ovate; spire moderately acute (apical angle varying from 55° to 65°, usually 60°), of five slightly convex, sculptured, gradually increasing whorls, and a smooth, rounded, small, swollen nucleus of one turn and a half; sutures twisted or subcanaliculated by a narrow flattened or hollow space separating the sutural line of conoidal tubercles, which are on the other side separated from the obtuse tubercular ends of the nearly straight longitudinal ribs by a deep spiral constriction or channel seeming to cut the ribs to the depth of the spaces between them; body-whorl obtusely rounded at the shoulder, rounding abruptly to the subsutural channel, and conoidally attenuated to a narrow slightly emarginate front; ribs thick, obtusely rounded (usually nineteen, rarely fifteen, and in one case twenty-four in the last whorl), usually becoming obsolete at about half the length of body-whorl (sometimes shorter and often somewhat longer), but becoming very prominent, and separated by rather wider, deep concave spaces, at the shoulder, where each terminates in an obtusely rounded end at the constriction or subsutural groove, above which each rib seems continued as a blunt conoidal tu-

bercle; a narrow, step-like, undulated, flattened or slightly concave space extends to the suture perpendicular to the axis; lower or anterior half of body-whorl strongly marked with transverse or obliquely spiral deep narrow sulci, having broader flattened spaces between them, occasionally extending more faintly a further variable distance towards the suture; mouth with a slight posterior channel, oblong, narrowed in front; outer lip smooth within (edge sometimes very faintly crenulated in old individuals); inner lip slightly curved, with four slender, oblique, nearly equal plaits about the middle, the anterior slightly longer than the posterior; occasionally traces of a very small fifth plait occur.

Usual length 1 inch 9 lines; body-whorl $\frac{72}{100}$ to $\frac{83}{100}$, penultimate whorl $\frac{13}{100}$ to $\frac{14}{100}$; width $\frac{43}{100}$ to $\frac{50}{100}$. Young, 5 lines long, body-whorl $\frac{75}{100}$, penultimate whorl $\frac{14}{100}$; width $\frac{50}{100}$: at this size only three sculptured whorls at the pullus, twenty-two ribs on body-whorl. Some species show that the mouth was dark violet within.

From the examination of a great number of specimens from the Lower Miocene or "Tongrien" beds of Lattorq, near Bemberg, I long ago satisfied myself that the *V. suturalis* and *V. cingulata* of Nyst were only extreme varieties of one species; and Beyrich seems somewhat inclined to the same opinion, from examination of a larger number of specimens from other localities, of one of the varieties at least, than Nyst seems to have had of either, as he marks them both as rare in his 'Coquilles et Polypiers Fossiles de Belgique;' and the latter name would be the best to retain, as it indicates the remarkable girdling of the whorls by the deep sulcus or constriction which seems to cut off a subsutural row of tubercles from the ends of the longitudinal ribs in the most common variety; still, as in the *V. bulbula*, Lam., to which Nyst likens the *V. suturalis*, specimens may be found showing all the transitions between the most strongly marked subsutural sulcus and its entire absence. The latter variety I mark *β. indivisa*; and in it the ribs are often fewer and more sigmoid, and the shell narrower, than in the ordinary forms, though none of these characters are constant; in this variety, too, the spiral striæ are often confined to the anterior base of the shell, leaving the body intact and the ribs smooth and polished. Var. *α. perstriata* has the ribs rather more numerous and straighter than in the ordinary type, and the spiral striæ very strongly marked over the whole body-whorl and spire, so as to be in this respect intermediate between the Hampshire Barton Clay *V. ambigua* and *V. digitalina*. In this variety the teeth sometimes reach six or seven; the obtuse swollen papillary "pullus" to the top of the spire readily separates it on compa-

rison of specimens; and the sutural space of the Australian species is never so deep or concave as in its European prototype, in which also the plaits on the columella are very much less conspicuous and more oblique, the anterior one alone approaching the size of the four on *V. anticingulatum*. The spire has one sculptured whorl, fuller than in the *V. cingulata* of Germany. There is no living species like it.

Very abundant, with occasionally the β variety and more rarely the α variety, *perstriata*, in the Tertiary sands of the Bird Rock beds, Ad. 22 to 21, less so in Ad. 23. Both varieties common in the sandy beds Ad. 24.

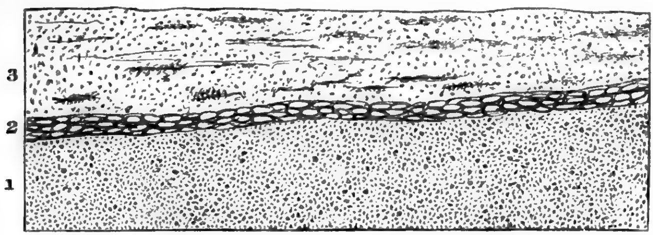
XLVIII.—*On a Phosphatic Deposit in the Lower Greensand of Bedfordshire*. By J. F. Walker, F.C.S., Sid. Suss. College, Cambridge*.

[Plate XIII.]

The Lower Greensand formation in Bedfordshire consists of extensive beds of variously coloured sands, more or less indurated into stone.

In the vicinity of Sandy there exists a conglomerate which it is proposed to discuss in this paper. A short account of this bed, by the Rev. P. B. Brodie, appeared in the 'Geological Magazine' for April. I sent a short paper on the discovery of some fossils in it to the 'Annals and Magazine of Natural History' for July; Mr. H. Seeley this month (August) also communicated his views on this bed in a letter to the Editors of that Magazine.

This conglomerate was formerly quarried for mending the roads, until two or three years since, when it was discovered that it contained nodules of phosphatic matter, for which it is at present extensively worked. At a cutting near the Potton Railway station the bed is from 9 inches to 1 foot in thickness; and the following is the section, the strata here being slightly inclined.



1. Sand of different colours, in some places white.
2. Conglomerate bed, 9 inches to 1 foot in thickness.
3. Sand of various colours, containing layers of oxide of iron, 12 feet.

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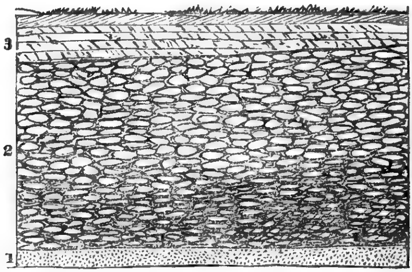
* Communicated by the Author, having been read before the British Association, in Sections B. and C., at Nottingham, 1866.

At a coprolite-working on the left side of the line, looking towards Cambridge, a few yards from the edge of the cutting, the bed increases in thickness to 2 feet.

At a large working on the hill the conglomerate bed is about 6 feet thick; the section is as follows:—



1. Sandstone, on which conglomerate rests.
2. Conglomerate bed, 6 feet.
3. Flaggy sandstone, not exceeding 1 foot in thickness (often less), and surface soil.

The lower part of the conglomerate is here darker in colour and more indurated than the upper.

On the other side of the road is another working, where the nodules lie in loose sand, and the phosphatic bed is about 1 foot thick.

There are several other workings in the neighbourhood.

The conglomerate contains phosphatic nodules and pebbles in about equal proportions. The bed is dug out and sifted, washed and laid in heaps, and then conveyed into sheds, where the nodules are picked out by hand. The quantity of phosphoric acid in the nodules varies from fifteen to twenty-two per cent.

It seems to be the opinion of Mr. H. Seeley that this bed is the southern extension of the Carstone, which, in a former paper*, he has stated to represent the Gault and the Shanklin Sands. But the Gault in this district is represented by a clay lying beneath the Upper Greensand. Therefore, if his views be correct, the term Carstone is inapplicable to this bed.

Mr. Seeley states that this deposit "reproduces earlier in time the conditions of the Cambridge Greensand."

The Greensand of Cambridge consists of a fine marl which effervesces briskly with hydrochloric acid; it also contains green grains, angular boulders, and hard dark-coloured nodules of phosphatic matter, often covered with *Plicatulæ*; lumps of iron pyrites are occasionally found. All the fossil shells are filled with the same material of which the nodules are composed.

* Quart. Journ. Geol. Soc. Nov. 1864.

The conglomerate of the Lower Greensand of Bedfordshire consists of ferruginous sand more or less indurated (which does not effervesce with hydrochloric acid), rolled pebbles, and light-brown nodules of phosphatic matter, which have an earthy fracture and often contain fragments of shells*. The nodules are often covered with perforations, which Mr. A. Wanklyn discovered to be the work of small bivalves†. Concretions of peroxide of iron are also found in this deposit.

The fossil shells found in this bed exist in two different conditions, some being casts composed of the same material as the nodules, whilst the shells of others are replaced by oxide of iron, and are filled with the same material of which the bed is composed; the indurated part of the bed also contains numerous impressions of shells. It is difficult to see how two formations presenting such marked points of difference can have been deposited under the same conditions.

The remains of organized bodies contained in this bed, as I have before stated, exist in two different states of mineralization, viz. as ferruginous shells and as phosphatic casts. The bed being very porous (a well has been sunk 50 feet deep for water) and largely impregnated with ferric oxide, shells (which, as is well known, consist chiefly of animal matter and calcic carbonate) would by the action of water have their calcic carbonate replaced by ferric oxide. In cases where the action was more rapid, only internal casts of the shells would remain.

Shells which lived in the sea whilst this bed was being formed, and also shells derived from older formations, if deposited in this bed, would undergo this change.

The phosphatic casts of shells must have been formed, or, at least, the shells must have been filled with phosphatic matter, before they were deposited here, and the calcic carbonate afterwards dissolved by the action of water. The tricalcic phosphate would be protected from the solvent action of water by the presence of calcic carbonate, as proved by the experiments of Mr. R. Warrington, junr., described in a paper read to the Chemical Society. The ferruginous shells and phosphatic casts are found intermixed.

The conglomerate contains lumps of hardened clay; and the so-called coprolites contain a much larger percentage of alumina than those of the Cambridge Greensand. The analysis of the coprolites is made from a commercial sample, which contains the shells, nodules, teeth, and bones, all ground up together. The

* In the interior of the nodules there are sometimes found specimens of a small species of *Lima* and of *Cardium*.

† Mr. Wanklyn has obtained several of these shells, which appear to belong to two or three different species.

amount of alumina with the fluorine and magnesia, in one analysis, is 6·64 per cent.; of course, if a special analysis of the nodules and phosphatic casts (the adhering sand having been carefully removed) were made, the percentage of alumina would doubtless be greater. This would indicate that the phosphatic nodules had been formed of clay soaked in decomposing animal and vegetable matter, since the alumina could not be derived from either animal or vegetable sources.

The question now to be considered is, whether all the remains of organic life found in this deposit are coeval with the deposition of the bed.

Mr. Seeley states that he has never obtained from this bed a fossil that is extraneous, and that they all appear to him to be "denizens of the old sea-bed where they abound."

There are obtained from this deposit large masses of silicified wood resembling those found in the Purbeck, also small pieces of wood mineralized with phosphoric acid, and often bored by a new species of *Pholas*, which I have named *Pholas Dallasii*.

It seems improbable that wood existing in two such different conditions should have been derived from the same source*.

Amongst the remains of animal origin we find rolled bones and teeth of reptiles and fishes, also shells of Mollusca, existing (as before mentioned) in two distinct conditions.

The phosphatic casts of shells are generally so much worn that it is impossible to identify their species with precision. In their general aspect they resemble those of the Kimmeridge and Oxford Clays. They consist of casts of *Rhynchonella*, of *Cardium, Arca, Pholadomya*, &c., of *Pleurotomaria, Chemnitzia, Natica*, &c.; three or four species of *Ammonites* occur, of which *Ammonites biplex* is found in great abundance; several of the Ammonites retain their nacreous lustre. Phragmacones of large Belemnites have also been found.

Part of the ferruginous shells also appear to have been derived from extraneous sources: amongst these I have obtained a specimen of *Exogyra virgula* and numerous specimens of *Gryphæa dilatata*. These shells, on account of their shape, could not contain phosphatic mud when they were deposited. They are in a bad state of preservation, which may be due to two causes, —first, to their having been rolled; and secondly, to their having at the time of their deposition lost part of their animal matter; therefore the removal of their calcic carbonate would be more rapid, and its replacement by the ferric oxide less perfect.

The other ferruginous shells appear to be of the age of the

* Since this paper was read, I have obtained a fine specimen of a cone probably belonging to a Cycadaceous plant of the Wealden age. Its length is 2·6 inches, and its circumference is 2·75 inches. (Pl. XIII. fig. 5.)

Lower Greensand, and do not present any traces of having been rolled. Amongst these I have determined

T. (Waldheimia) Tamarindus, *Sow.*	Pleurotomaria DeLahayesii, *D'Orb.*
—— celtica.	Pecten Robinaldinus, *D'Orb.*
Sphæra Sedgwickii, *n. sp.*	Ostrea macroptera, *Sow.*

I have also found ferruginous casts of other shells*. I have no doubt that this list will be largely increased.

The remains of fishes seem to be principally derived from the Kimmeridge Clay. I have obtained the following species, which have also been found in the Kimmeridge Clay of Ely, specimens of which may be seen in the Woodwardian Museum and in the collection of James Carter, Esq., who kindly informed me of the occurrence of these fishes at Ely:—

Sphærodus gigas, *Ag.* (Palatal teeth.) Very common.
Pycnodus, *sp.* (Palatal teeth.)
Gyrodus, *sp.* (Palates.)
Asteracanthus ornatissimus, *Ag.* (Dorsal spines.) Common.
Leptacanthus. (Spine.)
Hybodus, *sp.* (Spines and teeth.)
Sphenonchus.
Lepidotus, *sp.* (Scales.)
Psammodus reticulatus, *Ag.* (Palatal teeth.) Common.
Edaphodon, *sp.*

The remains of reptiles consist chiefly of rolled bones and teeth of *Plesiosaurus* and *Ichthyosaurus*; water-worn teeth of *Pliosaurus* (which reptile is characteristic of the Upper and Middle Oolites) also occur in considerable quantities. Some teeth of crocodilian character are found here as well as at Ely†.

I announced in the 'Annals of Natural History' the discovery in this bed of water-worn remains of the Iguanodon, which probably have been derived from the denudation of a deposit of Wealden which formerly existed near this district. Since then, I have obtained several more bones and teeth of this reptile. Mr. Keeping has likewise collected some fine specimens for the Woodwardian Museum, which previously contained no fossils from this deposit.

Further evidence of the existence of the Wealden at some period in this part of England has since been obtained by Mr. Keeping, whose practical acquaintance with this formation is well known: amongst the fossils collected by him are several

* Terebratula depressa, *Lamk.* Modiola æqualis, *Sow.* Exogyra conica, *Sow.* Myacites plicata, *Sow.* Plicatula, *sp.*

† Mr. H. Woodward, of the British Museum, kindly informed me that these teeth probably belong to a species of *Dakosaurus* (Quenstedt), which genus occurs in the White Jura.

pieces of the shelly limestone containing *Cyrenæ*, which in the Wealden occurs in layers varying from 1 to 6 inches in thickness.

From a careful consideration of these facts, the conclusion seems unavoidable, that the fossils contained in this deposit consist of some coeval with its formation, and also of organic remains derived from the denudation of the Wealden and of the Kimmeridge and Oxford Clays.

The following are descriptions of the new species referred to in this paper:—

Sphæra Sedgwickii, n. sp. Pl. XIII. figs. 1 & 2.

Shell globose, nearly equilateral, slightly gibbous, concentrically striated, the striæ finer and more distinct towards the ventral margin; ligament prominent; lunule large, distinct, cordate.

This shell is very plentiful, though it is rarely found perfect. The largest specimens hitherto obtained do not exceed the following dimensions:—length 1·6 inch, breadth 1·5 inch, thickness 1·3 inch.

In its general form this shell closely approaches *S. corrugata*, Sby. (=*Corbis cordiformis*, D'Orb.); the striation of the surface, however, is much finer, especially towards the margin; the lunule is very distinctly marked. The anterior margin is also destitute of the opening at the lower end of the lunule, represented in D'Orbigny's figure. I have obtained two specimens with the valves united, which show no traces of having been rolled. The other specimens are generally more or less fragmentary.

The fossil is named in honour of the venerable Professor who first discovered *Sphæra corrugata*.

Pholas Dallasii, n. sp. Pl. XIII. figs. 3 & 4.

Shell somewhat ovate, short, inflated, attenuated at the anal extremity, transversely divided by a single, nearly horizontal, punctate furrow; the surface on each side of the furrow finely striated; the striæ on the buccal side nearly parallel to the margin, those on the anal side less distinct, abbreviated, and obliquely directed towards the dorsal margin.

This little *Pholas*, which occurs in small pieces of wood mineralized by phosphatic salts, is very nearly allied to *P. Cornueliana*, D'Orb., from which, however, it seems to differ abundantly in its shorter form, which is more attenuated towards the anal extremity, the more horizontal direction of its single punctate furrow, and apparently the greater prominence of its umbones.

I have great pleasure in naming this fossil after my friend W. S. Dallas, Esq., F.L.S.

XLIX.—*Report on Dredging among the Hebrides.* By J. Gwyn Jeffreys, F.R.S.

[As this Report embodies important and recent papers by Professors Sars and Lovén, on the existence of animal life in great depths of the sea, which do not appear to be known in this country, I thought the subject would be sufficiently interesting to publish it at once in this form, without waiting for the appearance of the annual Report of the British Association for the Advancement of Science.—J. G. J.]

This exploration lasted nearly two months, viz. from the 24th of May to the 14th of July in the present year. It comprised Sleat Sound, Lochs Alsh, Duich, Slapin, and Scavaig, and the Minch from Croulin Island to Loch Ewe. I had a good cutter yacht, the master of which had been employed by me for many years as dredger and took considerable interest in the work, an active and willing crew, four serviceable dredges, 300 fathoms of new rope, machinery for hauling up the dredges, a large tub, sieves, and various other apparatus. The Hydrographer of the Navy obligingly supplied me with such charts as I required, to show the depths and nature of the sea-bottom in the district which I proposed to examine; and these were of great use in dredging, as well as for navigation. The weather was too fine; we were often becalmed for many hours together: and instead of steady breezes, we had too many of those squalls which are so prevalent, and occasionally dangerous, in the Hebrides.

The Hebridean seas have often been searched, but not explored, by zoologists. Their great extent, and the number of lochs and inlets which indent the coast in every direction, would render necessary an immense deal of money, time, and patience for a complete investigation. There is little probability that the subject of the present Report will ever be exhausted.

The invertebrate fauna of this district is of a northern character, although there are a few exceptions. Such are, among the Mollusca, *Trochus umbilicatus*, *Phasianella pulla*, *Rissoa cancellata* or *crenulata*, *Odostomia lactea* or *Chemnitzia elegantissima*, and *Pleurobranchus plumula*. These may be regarded as southern forms. The first and third occur as far north as Stornoway; the second ranges to Dunnet Bay in Caithness; of the fourth I dredged a single specimen in the upper part of the Minch; and the last lives between tide-marks in the Isle of Mull. As a set-off to the above, I would mention the following species, which have now for the first time been found so far south as the Hebrides, viz. *Montacuta tumidula* (a new species, which I will presently describe), *Trochus occidentalis*, var. *pura*, *Jeffreysia globularis*, and *Odostomia eximia*. The first is Swedish; the

second is Zetlandic, Scandinavian, and North American, although it has also been procured in the Orkneys and on the Aberdeenshire coast; the third is Zetlandic, and the fourth Zetlandic also and Norwegian. It must be borne in mind, as regards the extent of geographical distribution, that the southern extremity of the Shetland Isles is distant about 200 miles from the northern extremity of the Hebrides "as the fish swims." Besides the four last-named species, the following seem to reach their most southern limit in the Hebrides:—*Lima elliptica*, *Leda pygmæa*, and *Trochus Grœnlandicus*. *Leda pygmæa* has indeed been dredged on the coast of Antrim; but I am now inclined to regard the specimens thus obtained as quaternary fossils. *Tethea cranium* (a sponge not before known south of Shetland) occurred in tolerable numbers on the Ross-shire side of the Minch. Species of Mollusca, inhabiting the Hebridean seas, which are in the main northern (although they have been found somewhat further south, and some of them occasionally even in the Mediterranean), are—*Argiope cistellula*, *Pecten striatus*, *Mytilus phaseolinus*, *Modiolaria nigra*, *Crenella decussata*, *Nucula tenuis*, *Leda minuta*, *Arca pectunculoides*, *Montacuta ferruginosa*, *Cyamium minutum*, *Cardium minimum*, *Cyprina Islandica*, *Astarte compressa*, *Tellina pusilla*, *Scrobicularia nitida*, *Thracia convexa*, *Mya arenaria*, *M. truncata*, *Chiton Hanleyi*, *C. albus*, *C. ruber*, *C. marmoreus*, *Tectura testudinalis*, *T. fulva*, *Propilidium ancyloides*, *Puncturella Noachina*, *Emarginula crassa*, *Scissurella crispata*, *Trochus helicinus*, *Lacuna divaricata*, *L. puteolus*, *L. pallidula*, *Rissoa albella*, *Jeffreysia diaphana*, *J. opalina*, *Odostomia minima*, *O. albella*, *O. insculpta*, *O. diaphana*, *Velutina plicatilis*, *V. lævigata*, *Trichotropis borealis*, *Purpura lapillus*, *Buccinum undatum*, *Trophon Barvicensis*, *T. truncatus* or *Banffius*, *Fusus antiquus*, *F. gracilis*, *Nassa incrassata*, *Mangelia turricula*, *Defrancia scabra*, *Cylichna nitidula*, *Amphisphyra hyalina*, *Philine scabra*, *P. pruinosa*, and *P. quadrata*.

For certain species, which are almost peculiar to the Hebrides, I am not aware that any locality has been recorded between that district and the Mediterranean. Such are *Axinus ferruginosus*, *Poromya granulata*, *Neæra abbreviata*, *N. costellata*, and *Cylichna acuminata*. The first three of these were described by the late Professor Edward Forbes, in the Report to the Association in 1843 on Ægean Invertebrata. Another Hebridean species (*Nucula sulcata*) is not found southwards nearer than the coast of Spain.

Some of our most conspicuous and prized shells, that are also of a northern type, are wanting in the Hebrides. *Saxicava Norvegica*, *Natica Grœnlandica*, *Buccinum Humphreysianum*, *Buccinopsis Dalei*, *Fusus Norvegicus*, *F. Turtoni*, and *F. Berni-*

ciensis are in this category. All the above (with the exception of *Buccinum Humphreysianum,* which inhabits Shetland and the coasts of county Cork) are met with on the Dogger bank; and the first two are fossil in the Clyde beds. Six out of the seven being univalves, I would venture to surmise that their non-existence in the western seas of Scotland may have arisen from the circumstance that the diffusion of univalves is slower than that of bivalves. The spawn of the former is attached to the spot where it is shed, or in a few cases (e. g. *Capulus* and *Calyptræa*) it is hatched within the shell of its sedentary parent; so that the fry forms a colony, and need not roam to any distance, provided their station yields a sufficient supply of food and has the other requisites of habitability. Not so with bivalves. These shed their ova into the water, or else (as in some of the *Kellia* family) hatch them within the folds of the mantle, whence they are excluded on arriving at maturity. Their fry swim freely and rapidly by means of numerous encircling cilia. The metamorphic state lasts many hours. During that period they can voluntarily traverse considerable distances, or they may be involuntarily transported by tidal and oceanic currents. Time is the only element necessary for their widest dispersion over the adjacent seas, if no barrier intervenes. Should, however, such an obstacle present itself, whether in the shape of previously existing dry land, like that which separates the North Sea from the Atlantic, or from an upheaval and drying-up of the neighbouring sea-bed by geological or cosmical causes, the further diffusion of any marine animals in that direction must necessarily be stopped. An opposite result would doubtless be produced by a sinking and submersion of dry land below the level of the sea, whereby the diffusion of such animals would be greatly facilitated. This appears to have been the fluctuating course of events since the formation of the Coralline Crag, which was probably the cradle or starting-point of our molluscan fauna—a period long antecedent to the last glacial epoch, and incalculably far beyond the advent of man, unless his origin is much more remote than it is at present supposed to be. I am not inclined to attribute the northern character of some of the Hebridean mollusca to the persistence of what have been called "boreal outliers." The idea savours more of poetry than of philosophy or fact. The boreal or truly arctic species which once flourished in this district have become quite extinct, probably in consequence of one of those revolutions above suggested, by which the sea-bed was converted into dry land. These boreal species consist chiefly of *Rhynchonella psittacea, Pecten Islandicus, Astarte crebricostata* or *depressa, Tellina calcaria, Mya truncata,* var. *Uddevallensis, Trochus cinereus,* and *Astyris Holböllii*; and I have lately, as well as on a former

occasion, dredged them on the coasts of Skye and West Ross, at depths of from 30 to 60 fathoms, or 180–360 feet. They had a semifossilized appearance. Not one of the above-named species has ever, to the best of my knowledge and belief, been found in a living or recent state in any part of the British seas. All of them occur in post-tertiary or quarternary deposits on the west coast of Scotland, from a few feet above high-water mark* to 320 feet above the present level of the sea†. The greatest subaërial height (320 feet) being added to the greatest submarine depth as above (360 feet), gives an extent of elevation and subsidence equal to 680 feet. But as *Pecten Islandicus,* for example, now inhabits the arctic ocean at depths varying from 5 to 150 fathoms, let us take the average of these depths, viz. 77½ fathoms or 465 feet, and add it to the 680 feet. This would make 1145 feet, and probably represent the height at which the sea-level may be supposed to have stood when *P. Islandicus* lived on the highest fossiliferous spot noticed by Mr. Watson. The non-fossiliferous boulder-clay, indicating the simultaneous presence of arctic land which was also subject to glacial conditions, is stated by Mr. Watson‡ to be about 800 feet higher than the marine deposit. The height of the layer of sea-shells on Moel Tryfaen in Carnarvonshire (evidently the remains of an ancient beach) exceeds that of the similar deposit at Cardigan by more than 1300 feet; and the difference of height observed in the case of other fossiliferous deposits in the north of England (*e.g.* Manchester and Kelsey Hill) shows that the disturbing movement has been unequal, and probably not synchronous, over the same area. It would seem that the extent of such oscillation has not altogether amounted to 2000 feet in the British Isles, taking Moel Tryfaen as the greatest height, and the Shetland sea-bed as the greatest depth at which quaternary shells of recent species occur. The Scotch and Irish deposits, however, are on the whole far more ancient than those of Wales and England, judging from their geographical nature; the former are chiefly arctic, and the latter merely northern. Whether other parts of the North Atlantic sea-bed have undergone a much greater change of level since the tertiary epoch is not so well established. Dr. G. C. Wallich, in his admirable and philosophical treatise§, with which all marine zoologists and geologists are, or ought to be, familiar, believed that certain starfishes which he

* British Association Report, 1862, Trans. Sect. p. 73: Jeffreys, "On an Ancient Sea-bed and Beach near Fort William, Inverness-shire."

† Transactions of the Royal Society of Edinburgh, 1864, p. 526: Rev. R. B. Watson, "On the Great Drift-beds with Shells in the South of Arran."

‡ *Loc. cit.* p. 524.

§ The North Atlantic Sea-bed, 1862.

had procured at a depth of 1260 fathoms (7560 feet) in lat. 59° 27′ N., long. 26° 41′ W., about halfway between Cape Farewell and the north-west coast of Ireland, were originally a shallow-water species, but had gradually, and through a long course of generations, accommodated themselves to the abnormal conditions incident on the subsidence of the sea-bed*. The starfishes in question, which he refers to the *Ophiocoma granulata* of Forbes (*Asterias nigra* of O. F. Müller), appear, however, to belong to a different species, which inhabits deep water. In an important paper by Professor Sars, on the distribution of animal life in the depths of the sea†, he states that *Ophiocoma nigra* (*O. granulata*, Forbes) is certainly found in shallow water, viz. from 2 to 30 fathoms, on the coast of Norway, but never at a greater depth so far as is yet known, and that it does not range north of the firth of Drontheim. He is of opinion that Dr. Wallich's species is *Ophiacantha spinulosa* of Müller and Troschel, a well-known and Grœnlandic species, which is not littoral, but rather a deep-water kind, viz. from 20 to 190 fathoms; and he infers from Wallich's own account that the last-named species, instead of *Ophiocoma nigra* or *granulata*, was the one taken by the 'Bulldog'-sounding in 1260 fathoms. Dr. Wallich also adduces his discovery, at a depth of 682 fathoms (4092 feet), in lat. 63° 31′ N., long. 13° 41′ W., of two testaceous Annelids, which he assumed to belong to "known shallow-water forms," as further evidence of an extensive submergence of the North Atlantic sea-bed. These Annelids were named by him *Serpula vitrea* and *Spirorbis nautiloides*. But Professor Sars disputes their being shallow-water species. The former he identifies with his *Serpula polita* (=*Placostegus tridentatus*, Fabricius); the latter is referred by Mörch‡ to the *Serpula spirorbis* of Linné. The one is regarded by Sars as a deep-water and not littoral species, being found on the Norwegian coast in 20 to 300 fathoms; the other has a wide bathymetrical range, from low-water mark to 300 fathoms. I suspect, moreover, that there has been some mistake in the determination of the *Spirorbis*, and that it belongs to another species than that to which Wallich has assigned it. As to the accuracy of his statement that he procured living starfishes from a depth of 1260 fathoms, under the circumstances which he has described (viz. "convulsively embracing a portion of the sounding-line, which had been paid out in excess of the already ascertained depth, and rested for a sufficient period at the bottom to permit of their attaching themselves to it"), no reasonable

* *Loc. cit.* p. 41.

† Vid.-Selsk. Forhandl. 1864: Hr. Sars, "Bemærkninger over det dyriske Livs Udbredning i Havets Dybder."

‡ Naturhist. Tidsskr. 1863: "Revisio critica Serpulidarum."

doubt can be entertained. I have myself seen a number of *Antedon* (or *Comatula*) *celticus* clinging to the rope several feet from the dredge when it was taken up from about 60 fathoms. These starfishes must have crawled up the rope while the dredge was in motion or being hauled in, because no part of the rope had lain on the ground. Dr. Carpenter tells me that *Antedon rosaceus* has the same habit of crawling up and clasping a rope in shallow water.

The greatest depth marked on the Admiralty charts in any part of the Hebridean sea-bed which I examined is 132 fathoms. Here I got several kinds of living Foraminifera. Nineteen years ago I dredged near the same ground, in 116 fathoms, a fine cluster of one of the compound Tunicata, *Diazona Hebridica*, of a greenish-pink colour. I do not mention this as a great or even considerable depth. Sars* and Koren† have done much more on the coasts of Norway; their dredging-explorations extended to 300 fathoms. In the paper from which I have extracted the above remarks as to the distribution of animal life in the depths of the sea, Professor Sars has enumerated no less than 52 species and distinct varieties of animals found by him at the depth of 300 fathoms. They may be thus classified:—Porifera (Sponges) 2; Rhizopoda (Foraminifera) 19; Polypi (Actinozoa) 7; Mollusca (Polyzoa 8, Tunicata 1, Mollusca proper 10) 19; and Vermes (Annelida) 5. He has also specified several Echinoderms, Cirripeds, and Crustacea, as inhabiting somewhat less depths, viz. from 200 to 250 fathoms. The observations of the learned Norwegian zoologist confirm those of Sir James Ross and Dr. Wallich, namely:—

1st. That the temperature of the sea is uniform (39°·5 Fahr.) over the whole globe, below a certain line which forms an isothermal curve, with but slight oscillations caused by changes of the atmosphere. This curve has its greatest depth at the Equator, but reaches the surface of the ocean in lat. 56° 62′, and dips again as it approaches the pole from this point.

2nd. Although the pressure of the water is enormous at great depths, and in 300 fathoms is equal to about 56 atmospheres or 840 lbs. on the square inch‡, yet the most brittle and delicate animals (such as Polyzoa and Polyps) inhabiting such depths do not appear to suffer the slightest injury. Their structure is porous and permeable by liquids, or accessible to an endosmotic influence by which the pressure is easily resisted.

* Reise i Lofoten og Finmarken, 1849.

† Nyt Mag. Naturw. 1856.

‡ The Norse skaalpund is 10 per cent. more than the English lb. avoirdupois. Sixteen Norwegian square inches are equal to seventeen English square inches.

3rd. The want of light has always been considered an obstacle to the existence of animal life at great depths—not so much because light is directly essential to animal life, as on account of its indirectly contributing to its maintenance. It is generally supposed that animals are dependent on vegetable life. This latter, as is well known, cannot exist without light, under the influence of which the absorption of carbonic acid and the evolution of oxygen are effected. Light, however, exerts no such influence on animal life. Sea-weeds (the true Algæ) disappear in about 200 fathoms; and the only vegetable organisms which descend to a greater depth, say 400 fathoms, are Diatomaceæ. It may be observed, with respect to the action of light in producing colour in animals, that although intensity of light may produce a corresponding intensity of colour under ordinary circumstances, yet the diminution or absence of light in the sea is not necessarily followed by a diminution or absence of colour in marine animals. Those taken from considerable depths have frequently vivid colours. The animal of *Lima excavata* (a comparatively gigantic species), from 300 fathoms, is of the same bright red colour as those of *L. Loscombii* and *L. hians* from shallow water. It has been shown that red rays of light (*i. e.* actinic contradistinguished from luminous rays) penetrate deepest in the water. I will not here repeat what I have already published* on this interesting subject; but I may add that all the animals recorded as living at great depths are zoophagous, none of them phytophagous. The deep-sea dredgings of the Swedish Expedition to Spitzbergen in 1861 yielded some valuable results. Adjunct Professor Thorell and Professor Keferstein communicated some short and imperfect notices to the northern journals; but Professor Lovén has lately given us fuller information, which is published in the 'Transactions of Scandinavian Naturalists' at their ninth meeting held in 1863†. A Brooke's lead and a 'Bulldog' machine, with several improvements, were used on this occasion. Depths from 6000 to 8400 feet (1000–1400 fathoms‡) were thus explored. The sea-bottom at these depths was covered with a fine greasy-feeling material of a yellow-brownish or grey colour, rich in Diatomaceæ§ and Polythalamia, and nearly devoid of sand. Professor Lovén was furnished with the notes of

* British Conchology, vol. i. Intr. pp. xlviii–l, and vol. ii. Intr. pp. viii–xi.

† Stockholm, 1865: p. 384.

‡ The Swedish foot makes only 0·974 English foot. The Scandinavian fathom is 6 feet.

§ This does not quite agree with the accounts of Wallich and Sars, which give 400 fathoms as the limit of vegetable life; but it does not appear that the Diatomaceæ observed by Lovén had actually lived on the sea-bottom. They might have been pelagic and floating kinds.

Messrs. Chydenius and Malmgren, made during the expedition, and with all the animals discovered in those great depths. The latter comprised:—Annelida, viz. species of *Spiochætopterus* and *Cirratulus*; Crustacea, viz. a *Cuma* which appeared to be identical with *C. rubicunda*, Lilljeborg, and an *Apseudes*; Mollusca, viz. a *Cylichna*; Gephyrea, viz. a fragment of *Myriotrochus Rinki*, Steenstrup, and another allied form with large and fewer star-wheels, and of smaller wheels of the *Myriotrochus*-type; a species of *Sipunculus* resembling *S. margaritaceus*, Sars; and, lastly, a sponge, in which were found a Copepod or Ostracod, and a fragment of a *Cuma* resembling *C. nasica*. In the opinion of Lovén these animals indicate, so far as can be judged by so small a number, that in the abysses of the glacial seas there lives a fauna which does not greatly differ from that which lives on the same kind of bottom at much less depths. Proceeding upwards to the surface, from 50 or 60 fathoms the regions or zones have a greater variety of animals, even over the same kind of bottom. Taking this into consideration, and also recollecting that in the Antarctic seas, at measurable depths, there are forms of Mollusca and Crustacea which exhibit partly generic, partly almost specific identity with northern and hyperborean forms, the idea occurs to him that, from 60 or 80 fathoms down to the greatest depth known to be inhabited by animals, the bottom is everywhere covered with a soft and fine mud or clay, and that there exists from pole to pole, in all latitudes, a deep-sea fauna of the same general character, many species of which have a very wide distribution. He also thinks it probable that in the vicinity of both poles such a uniform fauna approaches the surface; while in tropical seas it occupies the depths of the ocean, the coast-line there being represented by vast regions of distinct faunas, the circumferences or areas of which are much more limited. But, in the face of the discovery made by Professor Sars that large Brachiopoda, stony corals, and Polyzoa, as well as certain Mollusca (e. g. *Anomia* and *Saxicava*) which are peculiar to a hard or even to a rocky bottom, inhabit a depth of 300 fathoms, and seeing that Dr. Wallich found a living *Serpula* attached to a stone at the depth of 682 fathoms, I am not prepared to accept, without considerable qualification, Professor Lovén's notion that the sea-bottom from 60 or 80 fathoms downwards is everywhere formed of soft material; indeed we need not go far from home to seek a refutation of this idea. Captain Beechey's dredgings off the Mull of Galloway, in 145 fathoms (as reported by the late Mr. Thompson, of Belfast, in the 'Annals and Magazine of Natural History' for September 1842, p. 21), yielded live specimens of *Chiton fascicularis*, *C. cinereus*, *Trochus millegranus*, and *Trophon Barvicensis*, all of which are inhabitants of hard or

stony, and never of soft ground, besides dead shells of the same and similar species. That is more than twice the average depth supposed by Professor Lovén to be the limit of hard ground. The Hebridean sea-bed, at very moderate depths (which Dr. Wallich would call "shallow water"), mainly consists of a soft and more or less tenacious mud, mixed with stones of different sizes, and resembling in its composition the boulder-clay or glacial drift of Scotch geologists. It tells us of rocks ground down by glaciers year after year in an arctic region—of the mud produced by such attrition being carried into the sea in the thawing-season by overwhelming floods, "non sine montium clamore" (see Dr. Kane's description of the great Humboldt glacier)—of its dispersion over the sea-bed by the action of tides and currents—of the deposit thus formed being inhabited by a variety of animals of a high northern type during a long and quiet course of time—of the sea-bed being elevated by slow degrees above the surface of the water by an agency which we cannot satisfactorily explain, but which may be volcanic, or perhaps caused by steam*—of the consequent extermination of these marine animals—of an interval during which the raised sea-bed was dry land—of a gradual amelioration of the climate—of another oscillation of the earth's crust in a downward direction, when the surface of the land, covered by its former deposit, again became the bottom of the sea—and of a fresh succession of life, which is still in existence. Thus a cycle of similar events continually recurs. Nothing is lost or altogether perishes; all the old materials are used up, and assume new forms. It is the fashion to quote Lucretius. I will only indulge in two lines; they seem not to be inapplicable to the present subject:—

> "Huc accedit uti quicque in sua corpora rursum
> dissoluat natura neque ad nilum interemat res."

The kind assistance of Mr. Alder, Dr. Carpenter, the Rev. A. M. Norman, Messrs. Henry and George Brady, Dr. M'Intosh, and Mr. Peach—all of them experienced zoologists—enables me to supplement this Report with notices of other departments of the invertebrate fauna, which have resulted from the last grant made to me. Several new species, especially among the smaller Crustacea, have occurred; and our knowledge of geographical distribution has been not a little advanced by the work. Mr. Norman's services especially deserve acknowledgment.

I have made my usual contribution to the British Museum.

* *Vide* Mr. R. A. Peacock's pamphlet 'On Steam as the Motive Power in Earthquakes and Volcanoes, and on Cavities in the Earth's Crust.' Jersey, 1866.

Description of a new species of Montacuta.
MONTACUTA TUMIDULA*, Jeffreys.

SHELL rhomboideo-oval, rather gibbous, thin, semitransparent, glossy, and prismatic: *sculpture,* numerous and close-set delicate, microscopical concentric striæ: *colour* yellowish: *epidermis* fine and silky: *margins,* on the posterior side extremely short and sloping downwards, without any of the angularity which characterizes *M. bidentata*; in front gently curved; on the anterior side considerably expanding and rounded; on the back rising towards the anterior end: *beaks* small, calyciform, blunt and prominent, incurved, but not having any indentation below them; they are placed close to the posterior side, which is the shortest and not one-sixth the size of the anterior side: *hinge-line* rectangular, occupying about one-third of the circumference: *cartilage* as in *M. bidentata*: *hinge-plate* narrow and strong, thicker in the middle, not excavated so deeply as in the last-named species, and scarcely at all in the right valve: *teeth,* in the right valve short, triangular, slightly inclining inwards, not widely separated; in the left valve long, erect, laminar, and parallel with the hinge-line; the anterior teeth are the largest in both valves: *inside* iridescent and polished, very finely marked (more distinctly on the anterior side) with slight lines which radiate from the beaks: *scars* irregularly oblong, conspicuous. L. 0·075. B. 0·1.

HABITAT. Muddy ground in the Minch off the north-west coast of Ross-shire, in 50–60 fathoms. I there found only a single dead specimen; but twenty years ago I dredged another in Skye, which I deferred noticing until I was quite satisfied of its differing from *M. bidentata.* [Since this Report was presented, Mr. Dawson has found two more specimens in some of the dredged sand which I had sent him.] Among the shells procured by Professor Lilljeborg in Bohuslän, on the south coast of Sweden, I observed two or three specimens of the present species, one of which he kindly gave me.

This shell is smaller than *M. bidentata*; it may also be distinguished from that species by its narrower shape, being convex instead of compressed, having a glossy surface, and by the posterior side being extremely small, with almost a perpendicular truncation. That side in *M. bidentata* is invariably squarish, and more or less angulated. The teeth in the right valve of *M. tumidula* are much smaller, and less widely separated by the

* Somewhat swollen.

cartilage-pit; they are triangular instead of leaf-like, and slightly incline inwards instead of being erect.

M. truncata of Searles Wood, from the Coralline Crag, is a comparatively large, squarish, and flattened shell, and has long cardinal teeth.

L.—*On* Hyalonema mirabilis, *in reply to Dr. Gray.* By Dr. Bowerbank.

In the 'Annals and Magazine' for October 1866, p. 287, Dr. Gray has published a note "On the 'Glass-rope' *Hyalonema,*" in which he has criticised the short observations on that genus in the first volume of my Monograph of the British *Spongiadæ*. Those observations were never meant to be taken as a history of the anatomy and physiology of that curious animal, but simply as an introduction to the genus *Hyalonema* among the Sponges, and as a reason for figuring the numerous interesting forms of its siliceous spicula among those of various other species of Sponges. The detailed account of these organs, except as far as it was necessary to illustrate the specimens selected for figuring, was reserved for a paper shortly to be published, and especially devoted to a minute investigation of the whole of the organization of the animal, including the basal mass of sponge-tissue, the spiculous axis, or rope, and its coriaceous envelope, with a view to establish the organic unity of these parts as portions of one and the same animal.

The criticisms of Dr. Gray are therefore somewhat premature; and in some respects he has so far misrepresented my opinions as to render a reply to his observations necessary. But in thus answering his remarks it must be understood that I shall not at present attempt to decide the questions in dispute, as to whether it be a single animal or two animals, the one parasitical on the other, and that I shall reserve the structural proofs and the reasonings necessary to such a decision for a paper on the subject, which I have long had in preparation and which I hope shortly to be able to publish.

In page 289 Dr. Gray writes, "Again, the specimens being sunk in a sponge that had a flat base by which it was attached to some marine body, I concluded that the natural habit of the animal was to develope itself in a sponge, so as to support itself in an erect position; and this idea was strengthened by finding that the sponge near the part where the coral perforated it was of a more condensed and harder texture than the other parts of it. I concluded that there was a kind of mutual understanding (such as we often find between animals that are parasitic on one

another) between the sponge and the coral." But, if this theory of Dr. Gray's be correct, the "mutual understanding" must have been carried very much further than the Doctor supposes—even to the extent of sharing the spicula of their respective skeletons between them, as the remarkable cylindro-cruciform siliceous spicula, so abundant in the inner coat of the envelope of the siliceous rope of spicula, are still more so in the body of the basal sponge. This uniformity in their anatomical structure, to an unprejudiced naturalist, would seem rather to identify them as parts of the same animal than of two distinct species, however closely attached by ties of "mutual understanding." But the truth appears to me to be, that, although Dr. Gray has had the British Museum specimen with the spongeous base under his care for many years, he has never yet made a careful microscopical examination of the tissues of its basal mass.

In page 291 he writes, "In 1860 Professor Max Schultze published the elaborate essay above quoted; and he regards the rope of siliceous spicula as part of a sponge, and the polypes as parasitic on it, calling the polypes *Polythoa fatua* mihi;" and he continues, "Dr. Bowerbank, adopting the same view, in his lately published work on British Sponges, gives the following as the generic character of the genus *Hyalonema*." This asertion is incorrect, as I have always maintained that the siliceous axis, its envelopment, and the basal sponge were all parts of the same animal, as the following generic characters I have proposed will prove.

Hyalonema, Gray.

"Skeleton an indefinite network of siliceous spicula, composed of separated elongated fasciculi, reposing on continuous membranes, having the middle of the sponge perforated vertically by an extended fasciculus of single, elongated, and very large spicula forming the axial skeleton of a columnal cloacal system" (vol. i. p. 196).

I will not at present follow the author of the paper through all his reasonings on the subject, as mere opinion or mere argument form by no means the best mode of settling such disputes, and as I shall shortly publish a full detail of my examinations of the anatomy and physiology of *Hyalonema*, in which, I trust, I shall be able to prove that the basal sponge, the spiral axis, and its coriaceous envelope are really parts of one and the same animal. There is another misrepresentation which I cannot allow myself to pass without comment. Dr. Gray, in page 292, writes, "Unfortunately Dr. Bowerbank does not seem to have considered it necessary to examine the specimens, but simply copies the plate, or to examine other genera of corals; or

he would have found that what he calls *oscula* are, as I called them in the description he quotes, polype-cells containing polypes having tentacles and all the internal organization, including a distinctly plicated stomach, exactly like the zoanthoid polype named *Polythoa* or *Corticaria*." How the stomach of the supposed polype can be like that of *Corticaria*, a genus of Coleopterous insects, is beyond my comprehension; but it may be that the author meant to write *Corticifera*, a generic name of Lesueur for *Zoanthus*. The assertion that I did not seem to have considered it necessary to examine the specimens is also inaccurate; and it must have escaped the memory of Dr. Gray that in 1860 the specimens alluded to were, by his direction, placed in my hands for examination, that for two days, during nearly four hours of each, I was engaged in the Entomological Department in a careful microscopical examination of their anatomical structures, and that a portion of the results of those examinations were published in the second part of my paper "On the Anatomy and Physiology of the Spongiadæ" in the 'Philosophical Transactions' for 1861, and were illustrated by no less than thirteen figures in two of the plates accompanying that Part. In plate xxxi., figures 3, 4, 5, 6, and 7, and in plate xxxvi. figures 12, 20, 30, 34, 35, 36, 37, and 38, are all from the specimen of *Hyalonema* in the British Museum, excepting fig. 7, plate xxxi., which is from the specimen in the Bristol Museum. I did not deem it necessary to refigure the specimen in the British Museum, as it had been so accurately and beautifully drawn by Mr. Ford for the 'Proc. Zool. Soc.' for 1857, plate ix. Radiata.

Dr. Gray blames me for supposed hasty conclusions and inaccuracies, and at the same time exhibits the like symptoms in his own observations: thus in page 288 he writes *Halichondra* in place of *Halichondria*, *Alcyonellum* (p. 293) instead of *Alcyoncellum*, and *Euplatella* in place of *Euplectella*, and, throughout the whole of the paper, *Polythoa** apparently instead of *Polyzoa*, or of *Palythoa*, Lamouroux, a genus of Zoanthidæ.

Dr. Gray adopts the idea of M. Barboza du Bocage, that the protuberant bodies from the bark of *Hyalonema* are allied to *Zoanthus*, and that they bear on their summits the tentacles of the polypes; and the figure of those parts by M. Barboza du Bocage in the 'Proceedings of the Zoological Society' for 1864, plate xxxiii. fig. 3, if he thinks fit to assume that as a correct representation of tentacula, would seem to justify him in that idea; but a little consideration would have informed him that the tentacles of polypes are always situated on the oral portion of the animal, and not on the surrounding portions of the

* [For this mistake the printer is to blame. It should have been *Palythoa* throughout, instead of *Polythoa*.—Ed.]

polypidom; and it may be observed that Dr. Gray, in p. 292, himself designates the protuberances which I have termed oscula as "polype-cells," and not as polypes. I have abundant specimens of *Corticifera*, and have had several of the polype-cases of *Zoanthus Couchii* in my possession, and in all my examinations of them I could never ascertain that the polypidoms of either secreted siliceous spicula. These bodies, in every case that has come under my observation, have been formed of aggregated adventitious materials, principally sand, with occasionally a stray spiculum amidst the heterogeneous material adhering to, and incorporated in, the fleshy cases of the polypes.

Dr. Gray is also mistaken in his belief that I have not paid sufficient attention to the structure of corals to enable me to escape such errors of judgment as he imputes to me; but the truth is, that in the course of the preparation of my paper "On the Organic Tissues in the Bony Structure of the Corallidæ," published in the 'Philosophical Transactions of the Royal Society,' vol. cxxvii. p. 215, I examined microscopically specimens of a great number of corals belonging to different genera, as well as many of the Gorgoniadæ, but have never succeeded in finding a single species of either of them which secreted silex as a material of its skeleton. Nothing was more common than to find a mixture of various forms of siliceous sponge-spicula deeply buried in the interstices of corals, and minute siliceous coating-sponges covering the bases and sometimes surrounding the stems of Gorgonias; but in both cases such spicula were decidedly either adventitious or parasitical; and I think I may safely challenge Dr. Gray to produce a single instance of either a true coral or a Gorgonia secreting siliceous matter as the base of its skeleton, or, indeed, of any other polype-bearing animal the earthy base of which is siliceous. The fact of the presence of siliceous spicula in the inner coat of what he terms the bark of *Hyalonema* should have warned him that it could not belong to either of the genera "*Corticaria*" (qu. *Corticifera*) or *Zoanthus*. Excepting among the Protozoa, I do not think Dr. Gray will find a single animal which secretes silex in its skeleton.

Dr. Gray writes, p. 290, that M. Barboza du Bocage states that the *basal* portion of the axis which is inserted in the sponge in some of the Japanese specimens is covered with the polype-bearing bark, the polypes near the *base* being smaller; but the passage quoted from M. Barboza du Bocage's paper by no means bears out this assertion of Dr. Gray. The quotation is as follows:—"Chez ces derniers (les exemplaires du Portugal) le *corium polypigerum* enveloppe l'axis d'une manière uniforme, il recouvre parfaitement *l'une* des extrémités de l'axis, la plus

étroite, et de là il s'étend sans aucune interruption jusqu'aux $\frac{2}{5}$ ou les $\frac{3}{5}$ de la longueur totale. Les polypes placés sur l'extrémité de l'axis sont les plus petits de tous (Proc. Zool. Soc. 1865, p. 663, and 1864, t. 22. fig. 2)." This misunderstanding of the passage quoted by Dr. Gray tends more than ever to confuse our ideas on the subject, whether we consider *Hyalonema* a coral, a zoanthoid polype, or a sponge. M. Barboza du Bocage certainly does not mean in the passage to infer that the thin end of the column covered with protuberances was the basal end, and was accordingly originally immersed in the basal spongious mass.

Dr. Gray has been pleased to say of my recently published Monograph of the British Sponges, "But all the descriptions of this work are so indistinct and crowded with technicalities peculiar to the author, that they are very difficult to understand, and render a new examination of the species and a new work on the subject requisite." I regret that I cannot furnish the learned author with any means of comprehending my descriptions except those contained in my volumes; but it is consolatory to know that there are other naturalists who can do so. No one has advocated the necessity of every newly discovered animal having a definite name more strongly than Dr. Gray; but that which is applicable to the whole animal does not, in his opinion, seem equally so to its parts. On this question I must beg leave to differ from him. I found a great portion of the British Sponges were new to our Fauna, and nearly all of their parts without names by which to designate and describe them. I was therefore compelled to name and describe both the component parts and the species; and whether I have or have not succeeded in employing suitable designations, I can assure the author of the paper that I should hail the accomplishment of a similar work to mine, exhibiting a greater amount of talent and research, with unfeigned pleasure, for the sake of the advancement of a branch of natural history the study of which has afforded me many years of pleasure and satisfaction.

LI.—*On the Systematic Position of the Pronghorn* (Antilocapra americana). By P. L. Sclater, M.A., Ph.D., F.R.S., Secretary to the Zoological Society of London*.

The author stated that his chief object in the present communication was to bring into more prominent notice a very impor-

* Abstract of a paper read before the British Association, Section D., Aug. 23, 1866. Communicated by the Author.

tant discovery regarding this animal, that had been made in the Zoological Society's Gardens in the Regent's Park during the past year, and had formed the subject of a paper read by Mr. Bartlett, the Superintendent of the Gardens, at one of the Society's meetings in 1865*. This discovery was, that the horns of the Pronghorn were naturally shed every year—a phenomenon hitherto quite unknown among the Bovidæ or hollow-horned Ruminants, with which the Pronghorn had always hitherto been associated, and only occurring in the allied Deer-family or Cervidæ. Mr. Bartlett's observations had been made upon a young male of this scarce mammal, which had been acquired for the Society in January 1865†, and had since lived in good health in the Menagerie. This animal had shed both its horns on the 7th of November, 1865; and a finer pair had since grown, which would, no doubt, be shed in like manner in Nov. 1866. Since Mr. Bartlett's publication of this novel fact, full confirmation of it had been received by the Zoological Society, in a communication from their Corresponding Member, Dr. Colbert A. Canfield, of Monterey, California, who had come to the same conclusion as Mr. Bartlett, from observations on this animal in a state of nature made in the county of Monterey, in some parts of which the Pronghorn was very common‡.

The author exhibited a skull of the Pronghorn with the horns fully developed and ready to be cast off shortly, and explained the mode in which he supposed the shedding to be effected. After the old horn was cast off, the horny matter, which was at first entirely confined to the upper end of the new horn, gradually spread itself down to its base, enveloping the numerous hairs with which the new horn was clothed when first appearing, and ultimately checking their growth and destroying their vitality. After the horn was perfected and hardened, new hairs developed themselves beneath the epidermis, and, not being able to force their way through the horny covering, became, as the author believed, the chief agent in causing the shedding of the horn. As regards the general structure of the horns of the Pronghorn, it was quite evident that they had little or nothing in common with those of the Deer. The latter were formed of bone developed upon a process of the frontal bone, and were more correctly termed *antlers*, whereas the horn of the Pronghorn consisted of true horn (like those of the ordinary Bovidæ) gradually developed

* "Remarks upon the Affinities of the Prongbuck," by A. D. Bartlett, Superintendent of the Society's Gardens. (Proc. Zool. Soc. 1865, p. 718.)

† See notice and figure, Proc. Zool. Soc. 1865, p. 60, pl. 3.

‡ See Dr. Canfield's paper "On the Habits of the Prongbuck, and the periodical shedding of its horns," Proc. Zool. Soc. 1866, p. 105.

from the epidermis, the skin remaining complete underneath them.

Two other points in which the Pronghorn differed from all the other known Bovidæ were the furcation of the horns and in the absence of the "false hoofs," as the stunted terminations of the rudimental second and fifth digits of each foot are termed, in which latter respect it resembled the Giraffes (*Camelopardalis*). These three important modifications of structure, when taken together, induced the author to believe that it would be necessary to raise the genus *Antilocapra* to the rank of a family in the series of Ruminantia, which he proposed to arrange somewhat as given in the subjoined table.

Order ARTIODACYLA.

Division RUMINANTIA.

I. RUMINANTIA PHALANGIGRADA.

Placenta diffusa. Stomachus tripartitus: dentes primores $\frac{1-1}{3-3}$, canini $\frac{1-1}{1-1}$, molares $\frac{6-6}{6-6}$ aut $\frac{5-5}{5-5}$: pedes didactyli .... 1. *Camelidæ.*

II. RUMINANTIA UNGULIGRADA.

a. Placenta polycotyledonaria. Stomachus quadripartitus: dentes primores $\frac{0-0}{3-3}$; canini $\frac{0-0}{1-1}$ aut $\frac{1-1}{1-1}$; molares $\frac{6-6}{6-6}$.

a'. Pedes didactyli, ungulis succenturiatis nullis.

a''. Cornua in sutura coronali posita, ossea, brevia, pelle tecta .... 2. *Camelopardalidæ.*

b''. Cornua ex osse frontali orta basi ossea, parte superiore cornea, furcata, decidua . 3. *Antilocapridæ.*

b'. Pedes tetradactyli, ungulis succenturiatis duabus.

c''. Cornua ex osse frontali orta, basi ossea, parte superiore cornea, non furcata, permanentia .... 4. *Bovidæ.*

d''. Cornua ex osse frontali orta, omnino ossea, decidua .... 5. *Cervidæ.*

e''. Cornua nulla, dentes canini marium exserti .... 6. *Moschidæ.*

b. Placenta diffusa. Stomachus tripartitus; dentes primores $\frac{0-0}{3-3}$; canini $\frac{1-1}{1-1}$, molares $\frac{6-6}{6-6}$; pedes tetradactyli; cornua nulla .... 7. *Tragulidæ.*

In conclusion the author called attention to the geographical distribution of the Ruminants, as shown in the subjoined table, in which the geographical divisions employed were the same as those used by the author in his paper on the distribution of

Birds*, but which he believed to be equally applicable to the class of Mammals.

Table of the Distribution of Ruminants.

	Orbis novus.		Orbis antiquus.			
	Regio Neotropica.	Regio Nearctica.	Regio Palæarctica.	Regio Æthiopica.	Regio Indica.	Regio Australiana.
1. Camelidæ	....	....	*Camelus*			
2. Camelopardalidæ	*Auchenia*					
	....	....	....	*Camelopardalis*		
3. Antilocapridæ......	....	*Antilocapra*				
	....	(*Haplocerus*)	*Antilope*	*Antilope*	*Antilope*	
	....	....	*Capra*	*Capra*	*Capra*	
4. Bovidæ	....	*Ovis*	*Ovis*	....	*Ovis*	
	....	*Ovibos*				
	....	*Bos*	*Bos*	*Bos*	*Bos*	
	....	*Tarandus*	*Tarandus*			
5. Cervidæ	*Cervus* ...	*Cervus*	*Cervus*	....	*Cervus*	
	....	....	....	....	*Cervulus*	
6. Moschidæ	....	....	*Moschus*			
7. Tragulidæ	....	....	....	....	*Tragulus*	
	....	....	....	*Hyomoschus*		

LII.—*On the Existence of* Hyalonema *in a Fossil State.* By Prof. E. Suess, of Vienna.

To the Editors of the Annals of Natural History.

Gentlemen,

A very interesting note on the "Glass-Rope *Hyalonema*," by Dr. Gray, in your last Number induces me to give the following supplement.

A very common fossil of the Yorkshire Mountain Limestone, described by M'Coy under the name "*Serpula parallela*," is, in fact, a true "Glass-Rope." Specimens of this curious fossil were first given to me by my excellent friend Mr. Edw. Wood, of Richmond, in 1861; and I took a good number of specimens with me to Vienna, because the siliceous nature of the fossil, in a rock the other fossils of which are not changed into silex, seemed to me to deserve some closer observation. I soon found out the cause of this curious difference, and published a note on the true relations of *Serpula parallela* in the 'Verhandlungen' of the Vienna Zoological Society for 1862 (vol. xii. pp. 85 & 86). I hope that English palæontologists, after having read this note and reexamined the fossil, will agree in naming it *Hyalonema parallelum*.

Yours most respectfully,
Edward Suess,
University, Vienna.

Vienna, Oct. 13, 1866.

* Journ. Proc. Linn. Soc. ii. p. 130.

LIII.—*Notulæ Lichenologicæ.* No. XI. By the Rev. W. A. Leighton, B.A., F.L.S.

On the Examination and Rearrangement of the Cladoniei, *as tested by Hydrate of Potash.*

In no case is the new reactive, hydrate of potash (see Annals & Mag. Nat. Hist. ser. 3. vol. xviii. p. 169), of greater practical utility than in the difficult tribe of the *Cladoniei,* that *crux* of lichenologists, where its application enables us with admirable precision and exactness to determine the various species, to redistribute the confounded species, and to refer to their proper systematic places the innumerable varieties and forms and endless modifications which may resemble each other in external characters. This will be amply manifest to the student by the following result of its application to the specimens in my herbarium. Where the reactive produces a yellow colour, it may be indicated by this sign, K+; where no reaction takes place, or only a slight fuscescence, thus, K−.

Tribe CLADONIEI, Nyl.

I. Pycnothelia, Ach., Duf., Nyl. (K+).

1. *P. papillaria* (Hoffm.) (Dill. t. xvi. f. 28, E. Bot. t. 907) =Schær. L. H. 511, 512; Nyl. Lich. Paris. 107; Moug. & Nestl. 259; Leight. Brit. Lich. 208; Mudd, Brit. Lich. 22; Mudd, Brit. Clad. 80; Coëmans, Clad. Belg. 1, 2, 3, 4; Anzi, Clad. Cisalp. 27; T. M. Fr. Lich. Scand. 16; Spruce, Lich. Pyren.

In addition to the above published collections, my herbarium contains the plant from Bagnères (Dr. Philippe), Genoa (Prof. DNtrs.), Smoland, Femsjö (Dr. T. M. Fries), Eperjes, Hungary (Dr. Holzinger), Westmoreland (Mrs. Stanger), Yorkshire (Mr. G. Dixon), Bournemouth, Hants (Rev. A. Bloxam).

2. *P. mascarena,* Nyl. Of this plant I have seen no specimen; but Dr. Nylander informs me (*in litt.*) that it has the same reaction (K+) as *P. papillaria.*

II. Cladonia, Nyl. (thallus leafy: see Flora, 1866, p. 178, and Ann. & Mag. Nat. Hist. 3 ser. xviii. p. 105.)

* *Phæocarpæ* (K+).

1. *C. endiviæfolia,* Fr. (Mich. Gen. t. 24. f. 3, E. Bot. t. 2361). The under surface of the thallus becomes of a faint yellow with hydrate of potash, which is not the case with *C. alcicornis,* thus showing them to be distinct. =Nyl. L. P. 106; Schær. L. H. 456; M. & N. 1062; Anzi, C. C. 1, 2; Coëm. *620; Welw. Crypt. Lusit. 35. 105; Mudd, B. C. 1.

My herbarium has it also from Rome (Dr. Deakin), Mödling,

Lower Austria (Dr. Holzinger), Algeria (Mr. G. Bentham), Genoa (Prof. DeNotaris); and, in Great Britain, from Gilton Point, Tenby, South Wales, and Haughmond Hill, Shropshire.

2. *C. cervicornis*, Schær. (E. Bot. t. 2574) = Schær. L. H. 457; M. & N. 749; Bohl. Br. Lich. 88; Anzi, C. C. 12, 18, 19; Mudd, L. Br. 9.

Under this name two plants, alike externally, have been comprised hitherto, but must now be separated as distinct species. The one has the reaction K +, the other is destitute of reaction, K —. Dr. Nylander (*in litt.*) informs me that the *C. cervicornis* of Délise's herbarium in the Jardin des Plantes, Paris, has K +, whilst the *C. sobolifera* of the same herbarium has K —, and to this latter Coëm. Cl. Belg. 14, 15, 16 are referable. The *C. cervicornis* K + is, of course, kept distinct from *gracilis* and *verticillata* by the reaction.

I possess this plant also from Bruyères (Schærer), from Götteborg and Christiania and Klippan, from l'Abbé Coëmans (as "*C. degenerans* v. *basima*, Nyl. L. Scand. 54"), and from Shropshire, Yorkshire, and Barmouth, North Wales.

3. *C. cariosa*, Flk. (E. Bot. Suppl. t. 2761) = Fr. L. S. 149 (fide specim. a Nyl.); Fellm. Lapp. 27; Coëm. Cl. Belg. 20; M. & N. 850; Massal. L. Ital. 54; Anzi, C. C. 4; Hepp. 541, 542; Schær. L. H. 510; Richardson, Arctic Amer. Lich. 10.

I possess this also from Upsal (Dr. T. M. Fries), Holm (Dr. Nylander), and from near the 49th parallel of latitude, Oregon Boundary Commission (Dr. Lyall).

The reaction K + keeps this quite distinct from *C. pyxidata*, K —.

4. *C. lepidota* (Ach.) = Fellm. Lapp. 35. This Acharian var. of *degenerans* has K +, and, in Dr. Nylander's opinion, ought probably to be distinguished as a distinct species.

5. *C. ecmocyna*, (Ach.) Syn. p. 261 = Fellm. Lapp. 28, 29; Anzi, C. C. 10 A & B (in part); Schær. L. H. 65. 271.

I have it also from Peklin (Dr. Harslingsky). Dr. Nylander (*in litt.*) remarks that this species grows as far as Greenland and Siberia. It is distinguished from *gracilis* by the reaction.

6. *C. dactylota*, Tuck. = Wright's Lich. Cub. 30. Distinguished from *fimbriata, gracilis,* and *botrytes* by reaction (K +), but may be probably added as a form to *ecmocyna*.

7. *C. turgida*, Hoffm. = Fr. L. S. 147 (fide specim. a Nyl. & T. M. Fries); Fellm. Lapp. 37; Tuck. L. Am. Sept. 24.

This also may be added to *ecmocyna* as a state.

8. *C. pungens*, Fr. (Dill. t. xvi. f. 30) = Fr. L. S. 318 (fide Nyl.); Schær. L. H. 459; M. & N. 754; Bohl. Br. Lich. 23; Coëm. 1035; Cl. Belg. 189; Bourgeau, Pl. Can. 605; Mudd, Br. Clad. 54, 55, 56; Anzi, C. C. 24; Leight. Exs. 16. 369, 374;

Wright, Cuba, 33; Wel. Cr. Lus. 26; Massal. It. 191, 196; Dietrich, Lich.

This I have also from Bagni di Lucca (Dr. Deakin); Blaeberry Hill, Perth (Dr. W. L. Lindsay), and from Barmouth, North Wales; also from Untersontheim (Kemler), Basingstoke, Kent, and Winchfield, Hants (Mr. R. S. Hill).

Distinguished from *furcata* (K—) by the reaction (K+).

Dr. Nylander communicates (*in litt.*) the following notes of reaction in specimens in the herbarium of Délise, which are referable here:—*C. racemosa*, Dél., K+ (this Dr. Nylander considers to be a *C. pungens* validior, and not belonging to the true *racemosa*). *C. racemosa*, var. *rangifera*, Dél., represents two species,—(1) *pungens major spermogonifera* (K+); (2) *corymbosa* (K—). *C. racemosa* var. *macropoda*, Dél., has K+.

Fries, L. S. 318, "*C. pungens*," has K+.

Var. *foliosa*, Flk. = Coëm. 1036; Coëm. Cl. Belg. 181, 183.

I possess this in addition from Leicestershire (Rev. A. Bloxam), Launceston (Sir W. J. Hooker), Hampshire (Mr. R. S. Hill), and from Algeria (Mr. G. Bentham), Salzburg (Dr. Schwartz).

Var. *coralloidea* (Ach.) = *C. muricata*, Dél. (Nyl. Syn. i. 207). Dr. Nylander (*in litt.*) says that *muricata*, Dél. herb., has K+, and is identical with *coralloidea*, Ach.

9. *C. corymbescens*, Nyl. (Nov. Caled. p. 40). This, Dr. Nylander says (*in litt.*), has the reaction K+ very distinct, and is much nearer to *C. pungens* than to *C. degenerans*.

10. *C. diplotypa*, Nyl. in Flora, 1862, p. 475. This has a beautiful reaction (K+), and, according to Dr. Nylander (*in litt.*), is near to *C. furcata* in appearance, but altogether distinct.

11. *C. delicata*, Flk. (E. Bot. t. 2052) = Schær. L. H. 75; M. & N. 753; Nyl. L. P. 14; Hepp. 112; Tuck. 29; Mass. 217, 292 B; Spruce, L. Pyren.; Anzi, C. C. 21 D; Coëm. Cl. Belg. 106, 107; Mudd, L. Br. 15, Br. Clad. 43; Leight. 382.

The reaction (K+) distinguishes this from *cæspiticia*, Flk. (K—), from *squamosa*, Hoffm. (K—), and from *pyxidata*, var. *pityrea* (Ach.) (K—).

I possess specimens also from Smolandia, Femsjö (Dr. T. M. Fries), Germany (C. Fuisting), and from Oswestry (Rev. T. Salwey), Bagot's Park, Staffordshire (Rev. A. Bloxam), Cold Weston, Shropshire, and Aymestry, Herefordshire.

Var. *subsquamosa*, Nyl. (E. Bot. t. 2362) = Schær. L. H. 74; Anzi, C. C. 21 B; Bohl. Br. L. 16; Mudd, Br. L. 14, Br. Clad. 41 (part.); Leight. 405.

In my herbarium are also specimens from Tatra, Hungary (Dr. Harslingsky), Stogdale, High Cliff, Cleveland, Yorkshire (Mr. Mudd), Bolsley, near Thirsk (Mr. J. G. Baker), Leicestershire (Rev. A. Bloxam), Northern Island, Australasia (Dr. J. D. Hooker).

The yellow reaction (K+) is observed in *C. delicata* and its varieties in the herbarium of Délise and also in his *C. syrtarum* and *C. squamosa* var. *anomæa*, Dél. (Dr. Nylander *in litt.*)

See remarks under *C. squamosa*, Hoffm. *posteà*.

12. *C. Santensis* (Tuck.). Of this Dr. Nylander says (*in litt.*), "Decidedly, after a renewed examination, *C. Santensis*, Tuck. Suppl.! and Nyl. Syn., is a *Cladonia* near to *delicata*, and not a *Pycnothelia*. Its reaction is strongly K+.

** *Phæocarpæ* (K−).

13. *C. alcicornis*, Flk. (Dill. t. xiv. f. 12 A; Vaill. Paris. t. 21. f. 3) = Schær. L. H. 455; Leight. Exs. 15; Coëm. Cl. Belg. 5, 6, 7, 8, 9, 10.

My herbarium contains this also from Bagni di Lucca and Rome (Dr. Deakin), Pont du Gard (Mr. G. Bentham), Lheris (Dr. Philippe), Ayton, Yorkshire (Mr. Mudd), Aberdovey (Rev. A. Bloxam), and from Bodbury Ring, near Church Stretton, Shropshire.

The want of reaction (K−) separates this from *C. endiviæfolia* (K+).

14. *C. firma*, Nyl. (Syn. p. 191). This, according to a specimen from Dr. Nylander himself (gathered by H. de la Perraudière on Teneriffe in 1855), has a peculiar red-brown, almost sanguineous, reaction, which I have noticed in no other plants. =Coëm. Clad. Belg. 11, 12, 13.

I possess similar specimens from Tatra, Lower Austria (Dr. Harslingsky), and from Christmas Harbour, Kerguelen's Land (Dr. J. D. Hooker).

15. *C. ceratophylla*, Eschw. = Wright's Cuba, 25; Spruce Lich. Amaz. 151.

I have it also from Mount Corcovado, near Rio de Janeiro (M. Casaretti).

16. *C. verticillaris*, Mnt. (fide spec. a DNtrs. collected by M. D. Casaretti in sylvulis Restinga de Taypú prope Rio de Janeiro, labelled *C. perfoliata*, Flk.) (Dill. t. xvi. f. 23) = Wright, Cuba, 27; Spruce, Amaz. 29.

In my herbarium are also specimens from Hong Kong (Mr. Wilford) and New Granada (Mr. Blagborne).

Var. *Dilleniana*, Flk. (Dill. t. xvi. f. 23) = Wright, Cuba, 34, 35.

The reaction here is peculiar, being, as Dr. Nylander remarks (*in litt.*), "thallus (vel podetiorum cortex) hydrate kalico fere, mox dilute fuscescens," as is the case also in *C. furcata* and *C. calycantha*. In the var. *Dilleniana* I should mention that the podetia exhibit no reaction, whilst the folioles become slightly tinged with yellow, which dries into a pale tawny colour.

17. *C. calycantha*, Dél. Of this Dr. Nylander has communicated a specimen from Bolivia, and informs me (*in litt.*) that the reaction is similar to that in *verticillaris* and *furcata*.

18. *C. pyxidata*, Fr. (Dill. t. xiv. f. 6 A, f. 6 C, f. 6 I–M, f. 9 A) = Tuck. Am. Sept. 25; Schær. L. H. 53, 54, 268, 270; Coëm. Cl. Belg. 23, 24, 25, 26, 27, 28, 29; Mudd, Br. Clad. 6; Nyl. L. P. 19; Rich. Arct. Am. 7, 12; Anzi, C. C. 3 A, C; M. & N. 1235, 1236 (part.), 1155 (part.); Massal. 128, 129; Arnold, 264; Leight. 407.

Specimens in my herbarium from Salzburg (Dr. Schwarz), Eperjes (Dr. Harslingsky), Sweden (Dr. T. M. Fries), Norway (Dr. W. L. Lindsay), and from Kent, Cumberland, Hants, Leicestershire, and Shropshire.

f. *leptophylla* (Flk) = Coëm. Cl. Belg. 22; Hepp. 543.

Dr. Nylander writes (*in litt.*) that Fellm. L. Arct. 25 is that which he has called *cervina* in his Syn. p. 193.

f. *pityrea* (Ach.) = Mudd, Br. Cl. 27, 28, 29, 30, 31, 32, 33; M. & N. 1235 (part.), 1155 (part.); Mudd, Br. L. 7, 8; Coëm. Cl. Belg. 47; Bohl. 32; Wright, Cub. 31; Schær. L. H. 266, 267.

Specimens in my herbarium from Salut (Dr. Philippe), Leicestershire, Shropshire, Yorkshire, Hants, and North Wales.

f. *decorticata* (Flk.) = Coëm. Cl. Belg. 87, 88, 89, 90, 91, 92, 93, 94, 95, 96, 97, 98, 99, 100, 101, 102, 103, 104; Wright, Cuba, 32 (part.); Coëm. 63, 1016, 1024.

Specimens in my herbarium from Untersontheim (Kemler), Engstlen Alp (Schærer), Grimsel (Schærer), and from Aberdovey, North Wales, and Leicestershire (Rev. A. Bloxam), Kilmory, near Fermoy, Ireland (Mr. I. Carroll).

f. *chlorophæa*, Flk. = Schær. L. H. 51*, 52, 54 (part.), 55; Mudd, Br. Cl. 7, 8, 9, 10, 11; Spruce, Amaz. 28; Coëm. Cl. Belg. 30, 31, 32, 33, 34, 35, 36, 37, 38, 29, 40; M. & N. 1235 (part.); Leight. 399.

Specimens in my herbarium also from Shropshire.

f. *cæspititia*, Flk. (E. Bot. t. 1796) = Leight. Exs. 368; Anzi, C. C. 21 E; Mudd, Br. Cl. 44; Coëm. Cl. Belg. 105; Bohl. 72; M. & N. 1154; Spruce, Lich. Pyren.; Hepp. 544; Arnold, 271; Schær. 269, 280.

Specimens in my herbarium from Holyhead Mountain, Anglesea, Caradoc, Lawrence, and Haughmond Hills, Shropshire; Pamber Forest, Hants (Mr. R. S. Hill); Bagni de Lucca (Dr. Deakin); Louvain, Bois de Héverlé (Abbé Coëmans).

f. *fimbriata*, Hoffm. (Dill. t. xiv. f. 8, t. xvi. f. 16, A, B, D, F, G; Vaill. Par. t. xxi. f. 6–8; E. Bot. t. 2438) = Mudd, Br. Cl. 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22; Richardson, 11; Coëm. Cl. Belg. 41, 42, 43, 44, 45, 46, 48, 49, 50, 51, 52, 53, 55, 56, 57, 58, 59, 60, 61, 62, 63, 64, 65, 66, 67,

68, 69, 70, 71, 72, 73, 74, 75, 76, 77, 78, 79, 80; Anzi, C. C. 7; Schær. L. H. 56, 57, 58, 59, 60, 61, 265, 589; Leight. Exs. 325, 376, 377; Bohl. 24; Fellm. Lapp. 26; M. & N. 1157, 1156; Nyl. L. P. 20, 21, 47, 48; Massal. 154, 155. Spruce, Lich. Pyren.

Other specimens in my herbarium from Salzburg (Dr. Schwarz), Salut (Dr. Philippe), Eperjes (Dr. Harslingsky), Genoa (Prof. De Notaris), Upsal (Dr. T. M. Fries), Australasia (Dr. J. D. Hooker), Fermoy, Ireland (Mr. I. Carroll), Leicestershire and Aberdovey, North Wales (Rev. A. Bloxam), Hants (Mr. R. S. Hill), Yorkshire (Mr. Mudd), Scotland (Dr. W. L. Lindsay), and Shropshire.

In all the polymorphous forms and states of *C. pyxidata* the reaction was K—, leaving a brownish stain when dry.

19. *C. subdelicata*, Nyl. Dr. Nylander writes (*in litt.*) that he is acquainted with a lichen from Tropical America which he has named *C. subdelicata*, analogous to *delicata*, but the cortex of whose podetia exhibits the reaction K—. Before knowing the difference of reaction he had mistaken it for *delicata*. This *subdelicata* is known to him as coming from the West Indies and Brazil. This is a correction which he wishes to be made in his Syn. p. 211.

20. *C. gracilis*, Hoffm. (E. Bot. t. 1284) = Richardson, Arct. Amer. 13, 14, 15, 16, 17; Mudd, Br. Cl. 34, 35, 36, 37; Mudd, Br. L. 10, 11, 12; Bohl. 7; Fellm. Lapp. 30; Coëm. 1021, 1022; Schær. L. H. 64, 66, 67, 68, 69, 641; Massal. It. 18, 19; Tuck. Am. Sept. 27*, 28; Anzi, C. C. 10 A (part.) C, D, E, F, G; Leight. Exs. 296, 402; M. & N. 849; Welw. Lusit. 119.

The above references comprise the forms *chordalis*, *macroceras*, and *aspera*, which I have also from the Pyrenees (Dr. Deakin), Lisponner (Dr. Philippe), Province of Pallantiensi (Prof. De Notaris), Tatra, Hungary (Dr. Harslingsky), Grimsel (Schærer), Salzburg (Dr. Schwarz), Upsal (Dr. T. M. Fries), Untersontheim (Kemler), Aldershot, Hants (Mr. R. S. Hill), Yorkshire (Mr. Mudd), Shropshire (Rev. T. Salwey), Keswick (Mrs. Stanger), Sedan, in Ardennes (Dr. C. Montagne), Barmouth, North Wales; Long Mynd, Stiperstones, and Wrekin, Shropshire.

Dr. Nylander states (*in litt.*) that Fr. L. S. 53, "*C. gracilis*," has K—, and comprises *hybrida* and *chordalis*.

Var. *cornuta* (*C. cornuta*, Fr. Nyl. Syn. i. p. 198) = Fr. L. S. 116 (fide spec. a Nyl.); Anzi, C. C. 9; Fellm. Lapp. 31; Richardson, Arct. Am. 18.

My herbarium contains also specimens of this form from Jerkin and Sneelhatten, Norway (Dr. W. L. Lindsay), Upsal (Dr. T. M. Fries), Holm (Dr. W. Nylander), Salzburg (Dr. Schwarz), Untersontheim (Kemler).

Var. *ochrochlora,* Flk. (Nyl. Syn. i. p. 198) = Arnold, 265; Schær. 640; Anzi, C. C. 8; Coëm. 1019; Hepp. 540; Coëm. Cl. Belg. 54, 81, 82, 83, 84, 85, 86, 110; Mudd, Br. Cl. 23, 24, 25, 26.

I possess also specimens from Austria (Dr. Holzinger), Lheris (Dr. Philippe), Bagni di Lucca (Dr. Deakin).

21. *C. verticillata,* Flk. (Vaill. Par. t. xxi. f. 5; Dill. t. xiv. f. 6, G, H) = Coëm. 1020; Tuck. Am. Sept. 26; M. & N. 644; Coëm. Cl. Belg. 17; Wright, Cuba, 28; Schær. L. H. 458; Mudd, Br. Cl. 3.

In my herbarium are also specimens from Untersontheim (Kemler), and Barmouth, North Wales.

Var. *sobolifera,* Dél. (in Dub. Bot. Gall. p. 631) = Schær. L. H. 62, 63, 274, 275; Tuck. Am. Sept. 27; Coëm. Cl. Belg. 14, 15, 16; Leight. Exs. 14; Mudd, Br. Cl. 2.

I have also specimens from Tatra, Hungary (Dr. Harslingsky), Subat (Dr. Philippe), Caer Caradoc and Lawrence Hill, Shropshire, Barmouth, North Wales.

The reaction K— is in the above fuscescent. Coëmans (Clad. Achar.) regards *verticillata* as the type of the species, and *cervicornis* (our *sobolifera*) as a simple microphylline variety. The true *cervicornis* has a reaction K+, which separates *sobolifera* (K—), which has hitherto, from external aspect, been confused and intermingled with it. Dr. Nylander (*in litt.*) informs me that *C. cervicornis* of Délise herb. has K+, and *C. sobolifera* of the same collection has K—.

22. *C. decorticata* (Fr) (Nyl. Syn. i. 199) = Schær. 279; Hepp. 545; Anzi, C. C. 5; Coëm. Clad. Belg. 21.

This I possess also from Upsal (Dr. T. M. Fries), Dagerö, Finland (Abbé Coëmans). Distinct from *cariosa* (K+) by reaction K—, and from *pyxidata* var. *decorticata* (Flk.) by the different squamules.

Dr. Nylander (*in litt.*) says *C. decorticata* (Fr.), Nyl. (of which *C. Mougeotii,* Dél., is a spermogoniferous state), has K—.

23. *C. degenerans,* Flk. = Fr. L. S. 54 (fide spec. a Nyl.); Richardson, Arct. Am. 19, 20, 21, 22, 23, 24, 25; Anzi, C. C. 13; var. *trachyna* (Ach.) = Fellm. Lapp. 34.

Of this species I have specimens also from Holm (Dr. Nylander), Upsal (Dr. T. M. Fries), Untersontheim (Kemler), Mount Splügen, Grimsel, Vall. Gastern (Schærer), Leicestershire (Rev. A. Bloxam), Basingstoke, Kent (Mr. R. S. Hill).

Dr. Nylander (*in litt.*) says *C. degenerans,* Fr. L. S. 54, has K—, and that *C. coralloidea,* Ach., which in his Lich. Scand. p. 54, he regarded as a variety of *degenerans,* is identical with *muricata,* Dél., and a variety of *C. pungens* (K+). All the *degenerans* of herb. Délise have K—.

24. *C. conchata*, Nyl. According to Dr. Nylander (*in litt.*) this has K—.

25. *C. carneola*, Fr. = Fr. L. S. 115 (fide spec. a Nyl.); Hepp. 1; Anzi, C. C. 6; Zwackh. 378.

This I possess also from Upsal (Dr. Nylander and T. M. Fries), Onega (Kullhem), Untersontheim (Kemler).

Var. *bacilliformis*, Nyl.

Var. *cyanipes*, Fr=T. M. Fr. L. Sc. 15.

Var. *cerina*, Nag. (Körbr. Par. 11). This, according to a specimen communicated by Dr. Holzinger, as received from Nagel himself, with the locality "near Dresden," has K—.

Dr. Nylander (*in litt.*) says, "Ex rev. Coëmans in litt. *Cl. straminea*, Smcf. non specie differt a *Cl. carneola*."

26. *C. botrytes*, Hoffm. (Hag. Hist. Lich. t. 2. f. 9)=Fr. L. S. 80 (fide spec. a Nyl.); Hepp. 539; Massal. 180; Fellm. 36; Körbr. 242; T. M. Fr. L. Sc. 14.

Upsal (Dr. Nylander and T. M. Fries), Gratz, Austria (Dr. Holzinger), Onega (Kullhem).

27. *C. pileata*, Mont. This, according to Dr. Nylander, has K—. =Spruce, Amaz. 37 (non typica); 27 (f. *lepidotella*, Nyl.).

28. *C. mitrula*, Tuck.=Wright, Cuba, 40.

The reaction K— keeps this distinct from *C. cariosa* K+.

29. *C. substraminea*, Nyl. According to Dr. Nylander (*in litt.*) this has K—.

30. *C. athelia*, Nyl. (Syn. i. p. 204) = Spruce, Amaz. 26; Wright, Cuba, 26 (f. *macrophylliza*, Nyl.). Dr. Nylander writes (*in litt.*) that this is a true *Cladonia* and not a *Pycnothelia*, and that its reaction is K—.

31. *C. furcata*, Hoffm. (Dill. t. xvi. f. 27. A & C) = Tuck. 33; Coëm. Cl. Belg. 173, 174, 176, 177, 178, 179, 180, 182, 184, 187, 188, 190, 191, 192, 193, 194, 195, 196, 197, 198; Mudd, Cl. Br. 49, 50, 51, 52, 53; M. & N. 852; Leight. Exs. 16, 401; Richardson, 26; Coëm. 1029, 1033, 1034; Anzi, C. C. 23, E, F; Schær. 81; Mudd, Br. L. 16.

Also from Upsal (Dr. T. M. Fries), Lübeck (Dr. Holzinger), Inniscary, Cork (Mr. I. Carroll), Leicestershire (Rev. A. Bloxam), Kent (Mr. R. S. Hill), and Shropshire.

Var. *racemosa*, Flk. (Dill. t. xvi. f. 27 B) = Tuck. 32; Nyl. L. P. 23; Mass. 158; Mudd, Br. Cl. 46?, 47; Anzi, C. C. 23, A, B, D; M. & N. 851; Schær. 80.

Also from Subat (Dr. Philippe), Stundschüpf (Schær.), Rome (Dr. Deakin), Salzburg (Dr. Schwarz), Eperjes (Dr. Harslingsky).

Dr. Nylander notes (*in litt.*) the following in herb. Délise:— *C. racemosa*, var *humilis*, Dél. K—. *C. racemosa*, var. *foliolosa*, Dél. K—.

f. *adspersa*, Flk. = Coëm. Cl. Belg. 175. In my herbarium I have this state from Gand (Abbé Coëmans), Isus, Sima (Wilford), Australasia (Colenso).

f. *recurva* (Hoffm.) (Dill. xvi. f. 27 D) = Richardson, 26; Mudd, B. C. 48, 49; Coëm. Cl. Belg. 185.

This state I have from Louvain (Abbé Coëmans), Bagni di Lucca (Dr. Deakin), Pyrenees (Dr. Deakin and Mr. Spruce), Yorkshire (Mr. Mudd), Leicestershire (Rev. A. Bloxam), and Shropshire.

Var. *corymbosa*, Nyl. = Coëm. Clad. Belg. 184, 187, 188, 190, 191, 192, 193, 194, 195; Coëm. 1030; Nyl. L. P. 22.

This I have from Northern and Middle Islands and St. Patrick's River (Colenso), Australasia (Dr. J. D. Hooker), British Columbia (Dr. Lyall), Subat (Dr. Philippe).

Dr. Nylander notes these reactions in herb. Délise:—*C. racemosa*, var. *microcarpa*, Dél., K— = (mihi *corymbosa*); *C. racemosa*, var. *thyrsoidea*, Dél., K— = (*corymbosa*); *C. tortuosa*, Dél., K— = (*corymbosa*); *C. racemosa*, var. *rangifera*, Dél., is partly *corymbosa*, K—; and that Fries, L. S. 58, "*C. racemosa*," has K dilute fuscescens (= *corymbosa*); and also Fries, L. S. 117, "*C. subulata*," K dilute fuscescens, and comprises (1) *subulata* (= ♂), (2) *corymbosa* (= ♀), and (3) *furcata*, tenuis fuscescens (K—).

Var. *spinosa*, Flk. (Dill. t. xvi. f. 25) = Coëm. Clad. Belg. 180, 186.

This I have also from Kifferschwyl (Schærer), Genoa (Prof. De Notaris).

Dr. Nylander (*in litt.*) remarks that it will be necessary to separate the *C. spinosa* (Flk.), given in Coëm. Clad. Belg. 180, under the name *C. furcata*, and with the synonym "*C. furcata η racemosa* subv. *spinosa* in hb. Flk.," and again in No. 186 under the name of "*C. furcata*," inasmuch as these two numbers have the free reaction K+, which here indicates only a distinct variety; for there is frequently in *furcata* and *corymbosa* a slight yellowish reaction which quickly turns to fuscescent. See also remarks under *C. verticillaris*, anteà.

Var. *crispata*, Flk. = Schær. 276, 277; Tuck. 31; Mudd, Br. C. 45; Coëm. Cl. B. 199, 200; Richardson, 27, 28, 29; Fellm. 32, 33; Anzi, C. C. 22.

Dr. Nylander (*in litt.*) remarks that he considers *crispata* to be nothing more than a variety of *furcata*; just as *amaurocræa* is of *uncialis*.

I possess also specimens of *crispata* from Lheris (Dr. Philippe), Peklin (Dr. Harslingsky), Bagni di Lucca (Dr. Deakin).

32. *C. grypea*, Tuck. (in Agass. Journey to Lake Superior, App.), is, according to Dr. Nylander (*in litt.*), distinct from *tur-*

gida, and approaches *C. furcata* in the same way as *turgida* approaches to *pungens.* *C. grypea* has K—.

33. *C. cenotea,* Schær. = Fr. L. S. 55 (fide spec. a Nyl.); Anzi, C. C. 20; Zwackh. 329; Massal. 156; Schær. L. H. 71; Coëm. Cl. Belg. 116, 117, 118, 119.

My herbarium also comprises specimens from Upsal (Dr. W. Nylander and Dr. T. M. Fries), Jerkin, Norway (Dr. W. L. Lindsay), Untersontheim (Kemler), Mahourat, Pyrenees (Mr. Spruce).

Var. *glauca,* Flk. = Schær. L. H. 460; Zwackh. 330; Coëm. Clad. Belg. 111, 112, 113, 114, 115; Coëm. 1028.

I have it also from Untersontheim (Kemler).

34. *C. squamosa,* Hoffm. (E. Bot. t. 2362) = M. & N. 645; Anzi, C. C. 21, A, C; Schær. L. H. 72, 73, 278; Massal. 292, A. C.; Mudd, L. Br. 13; Tuck. 30; Coëm. *1025, 1026, 1027; Zwackh. 379; Mudd, Br. Cl. 40, 41 (part.), 42.

In my herbarium are also specimens from Upsal (Dr. T. M. Fries), Kirjavalaks, Finland (Kullhem), Untersontheim (Kemler), Pyrenees (Dr. Deakin), Mount Gaillard, Pyrenees (Mr. Spruce), Subat (Dr. Philippe), Bagni di Lucca (Dr. Deakin), Nisay (Breutel), Leicestershire (Rev. A. Bloxam), and Shropshire.

Here is another instance of two different plants being united by external characters under the same name, but which are readily separated and arranged properly by the hydrate of potash.

Dr. Nylander (*in litt.*) remarks that the name *squamosa,* being the best-known and the most common one, ought to be definitely reserved for that lichen which is the most developed, *i. e.* that which does not manifest the yellow reaction with the hydrate of potash. The lichen, on the contrary, the cortex of whose podetia becomes yellow with this reactive (K+), and which has frequently the aspect of *squamosa,* but is much more rare, can be nothing more than a variety (*luxurians* or *subsquamosa*) of *C. delicata,* which, by the reaction (K+), shows itself to be distinct from *squamosa* (K—).

In the herbarium of Délise, Dr. Nylander has noted with the reaction K— the following varieties of his *squamosa,* viz. *tenuiuscula, scabrosa, simplex, muricella, crassa, elegans, paschalis, frondosa, flabellata, rigida,* as well as his type of this species. The same absence of reaction is visible in his *C. cucullata* (which scarcely differs from *squamosa,* var. *frondosa,* and which Dr. Nylander says he has, in his Syn. p. 210, incorrectly referred to *delicata*) and *speciosa.*

On the other hand, the yellow reaction (K+) is observed in *C. delicata* and its varieties in the herbarium of Délise as well as in his *C. syrtarum* and *C. squamosa,* var. *anomæa,* Dél,

*** *Erythrocarpæ* (K+).

35. *C. digitata*, Hoffm.=Fellm. 45; Anzi, C. C. 18; Schær. L. H. 43, 44, 46; Tuck. 39; Nyl. L. P. 25; M. & N. 751 (in part); Mudd, Br. Cl. 68, 69, 79.

This I also possess from Upsal (Dr. T. M. Fries), Untersontheim (Kemler), New Zealand (Mr. Allan Cunningham), Kotzebue Sound (Dr. J. D. Hooker), Subat (Dr. Philippe), Salzburg (Dr. Schwarz), Tatra, Hungary (Dr. Harslingsky), Eichstatt (Dr. F. Arnold), Popertfort (Dr. Harslingsky), Canaries (P. B. Webb), Australasia (Dr. J. D. Hooker), Wallington (Sir W. C. Trevelyan), Leicestershire (Rev. A. Bloxam), Oswestry, Shropshire (Rev. T. Salwey).

Dr. Nylander writes (*in litt.*) that the *digitata* of Délise's herbarium, with its varieties, has the yellow reaction with hydrate of potash (K+), except the variety *mucronata*, Dél., which does not manifest any reaction (K−). This *mucronata* belongs to *bacillaris*.

Var. **macilenta*, Hoffm., p. p.=Hepp. 113; Bohl. 8; Anzi, C. C. 19 B, C; M. & N. 750; Schær. L. H. 33, 34; Mudd, Br. L. 23, Br. Cl. 72, 74, 75, 76.

Subat (Dr. Philippe), Austria (Dr. Holzinger), Craigforda, Shropshire (Rev. T. Salwey), Westmoreland (Mrs. Stanger), Leicestershire (Rev. A. Bloxam), Moel y Golfa and Barmouth, North Wales, Wrekin and Long Mynd Hills, Shropshire.

f. *clavata*, (Ach.) E. Bot. 2028; Dill. t. xv. p. 14 B=Schær. 35; Leight. Exs. 297, 371, 275, 403; Mudd, Br. L. 29, Br. Clad. 68, 69, 79.

Also from Austria (Dr. Holzinger), Leicester (Rev. A. Bloxam), Guisbro' Moor, Yorkshire (Mr. Mudd), Nescliffe Hill, Wrekin Hill, Long Mynd, Laurence Hill, Shropshire.

f. *polydactyla*, Flk.=Mudd, Br. L. 28, 27, 26; Hepp. 537; Mudd, Br. Cl. 77, 78; Leight. Exs. 274; Schær. 454.

Also from Fontainebleau (Abbé Coëmans), Untersontheim (Kemler), Cumberland (Mrs. Stanger), Leicestershire (Rev. A. Bloxam), Craig-y-Barns, Dunkeld (Dr. W. L. Lindsay).

Here is another instance of two different plants having been confused under one and the same name. On detecting their distinction by the hydrate of potash, I communicated with Dr. Nylander as to the proper nomenclature, and he replies (*in litt.*) thus:—"The '*macilenta* K−' is more common and better developed than the '*macilenta* K+,' and is most frequently found in the ancient herbaria under the name of *C. bacillaris*. Call it, then, *C. Flörkeana *bacillaris*, Ach. et auct. pro max. p. The name **C. macilenta*, Hffm. pr. p. will then be appropriated to the other (K+), which certainly passes into *digitata*. The

C. bacillaris var. *clavata*, Dél. hb. gives K+, which proves that it must be united with *macilenta*. In Fries (L. Suec. 52) the specimens of *macilenta* and *bacillaris* are intermingled, but the ticket bears the name '*C. macilenta*.' There exists also a state of *macilenta* with granulated cortex and with the reaction (K+) analogous to *Flörkeana*." *C. albicans* varr. *carcata* and *pseudocornuta* of Délise have K+.

36. *C. rigida*, Tayl. (in Lich. Antarct. 119; Nyl. Syn. 1. 224 n.).

Of this antarctic species I have seen no specimen. Dr. Nylander (*in litt.*) says it belongs to the series K+, and is near to *C. digitata*.

**** *Erythrocarpæ* (K−).

37. *C. sanguinea*, Flk. Of this I only possess a small fertile specimen from Dr. J. D. Hooker, without locality.

Var. *anæmica*, Nyl. (Syn. i. 219). This, Dr. Nylander informs me (*in litt.*), has the reaction K−.

38. *C. insignis*, Nyl. This, Dr. Nylander says, has K−.

39. *C. cornucopioides*, Fr. (E. Bot. t. 2051) = Richardson, 30, 31, 32, 33, 47, 48, 49; Schær. 50, 51; Heppe, 538; Fellm. 43; Anzi, C. C. 14, 15; M. & N. 751 (in part), 752; Massal. It. 213; Tuck. Am. Sept. 37; Mudd, Br. Cl. 65, 66, 67; Leight. Exs. 376, 404; Spruce, Amaz. 32, 33 (f. *gracilescens*, Nyl.).

My herbarium contains also specimens of this, in its various modifications and states, from Untersontheim (Kemler), Upsal (Dr. T. M. Fries), Labrador (Breutel), Australasia (Dr. J. D. Hooker), Subat and Lheris (Dr. Philippe), Leicestershire and Aberdovey, North Wales (Rev. A. Bloxam), Yorkshire (Mr. G. Dixon), Basingstoke, Kent (Mr. R. S. Hill), Barmouth and Cader Idris, North Wales, Wrekin, Caradoc, Long Mynd, Stiperstones Hills, Shropshire.

40. *C. bellidiflora*, Schær. (E. Bot. t. 1894) = T. M. Fries, L. Scand. 12; Massal. 173; Anzi, C. C. 16; Schær. L. H. 39, 40, 41, 42; Fellm. 46.

Of this my herbarium contains specimens also from Savoy (Dr. W. Nylander), Newfoundland (Sir W. J. Hooker), Tatra, Hungary (Dr. Harslingsky), Grimsel (Schærer), Ben Lomond, Scotland, 1823 ft. (Sir W. J. Hooker).

Var. *Hookeri*, Nyl. (Syn. i. 221) = Spruce, Amaz. 36, 38.

I incline to think that this and the following, *deformis*, may be united with *cornucopioides*, as being states only of the same plant under different development resulting from locality, situation, and humidity.

41. *C. deformis*, Hoffm. (E. Bot. t. 1394; Dill. t. xv. f. 18 A) = Fellm. 44; Anzi, C. C. 17; Richardson, 50, 51, 52, 53, 54;

Schær. L. H. 45, 47, 48, 49; Mudd, Br. L. 25; Bohl. 39; Tuck. 38.

This I possess also from Mount Splügen and Engstlen Alp (Schærer), Jerkin and Sneelhatten, Norway (Dr. W. L. Lindsay), Kotzebue Sound (Dr. J. D. Hooker), Subat (Dr. Philippe), Salzburg (Dr. Schwarz), Untersontheim (Kemler), Leicestershire (Rev. A. Bloxam).

Is not this also a state of *cornucopioides*?

42. *C. muscigena,* Eschw. = Wright, Cuba, 42; Spruce, Amaz. 34.

43. *C. gracilenta,* Tuck. (Obs. Lich.) = Wright, Cuba, 43.

44. *C. Flörkeana,* Fr. = T. M. Fr. L. Scand. 13 (in part).

My herbarium contains it also from Bahusia (Dr. T. M. Fries), Lochrmoos (Schærer), Germany (Dr. Dietrich), Yorkshire (Mr. G. Dixon), Doveraile Mountains, Ireland (Mr. I. Carroll).

Var. **bacillaris,* Ach. & auct. pro max. p. = Schær. L. H. 36, 37; Mudd, Br. L. 24, Br. Cl. 70, 71,73; Leight. Exs. 56.

This also I have from Salzburg (Dr. Schwarz), Austria (Dr. Holzinger), Belgium (Abbé Coëmans), Leicestershire (Rev. A. Bloxam), Cheshunt, Hants (Mr. Archer), Basingstoke, Kent (Mr. R. S. Hill), Craigforda, Shropshire (Rev. T. Salwey), Barmouth, North Wales, Long Mynd, Wrekin, Stiperstones, Laurence, Caradoc, Abdon Burf Hills, Shropshire.

This has been hitherto, by external aspect, confused with *C. macilenta* (K+), but is separated by different reaction (K—), and is only a var. of *Flörkeana* analogous as *pleurota* is to *cornucopioides.* For various remarks connected with it, see under *C. macilenta,* anteà.

The following remarks are from Dr. Nylander's annotations on the types of *Cenomyce* of Délise, in his herbarium at the Jardin des Plantes, Paris, which he has liberally communicated (*in litt.*) to me:—*C. digitata* var. *mucronata,* Dél. hb., has K—, and *C. albicans,* Dél., has K—, and therefore are referable to *bacillaris.* The *C. bacillaris,* Dél., and his varieties *styracella, macrocarpa, densiflora, paleata, coronata,* according to the specimens in herb. Délise, have K—, and belong to *C. Flörkeana *bacillaris.*

Var. *ostreata,* Nyl. (Syn. i. p. 225) = Nyl. L. P. 108.

Of this Dr. Nylander writes (*in litt.*), "Ob podetia *Cladoniæ bacillaris* immixta squamis parum evolutis *Lecideæ ostreatæ* sterilis, olim credidi Lichenem in L. P. 108 datum varietatem sistere *Cladoniæ* illius squamis recedentibus. Quod corrigendum est, et varietas nomine '*ostreata*' delenda."

45. *C. sphærulifera,* Tayl. = Spruce, Amaz. 31. K—.

46. *C. cetrarioides,* Schwein. = Spruce, Amaz. 35, 39. K—.

III. Cladina, Nyl. Thallus leafless. (See Flora, 1866, p. 178, and Ann. & Mag. Nat. Hist. ser. 3. xviii. p. 105.)

* *Phæocarpæ* (K+).

1. *C. rangiferina*, Hoffm. (E. Bot. 173; Dill. t. xvi. f. 29 a & b) = Schær. L. H. 76, 77; Anzi, C. C. 25 a (in part); Spruce, L. Amaz. 17; Richardson, L. Arct. Am. 31, 32; Wright, Cub. 38, 39; Mudd, Br. L. 19; Wagner, Lich. 22; Fellm. Lapp. 38; M. &. N. 72 (part.); Mudd, Br. Cl. 58; Coëm. Clad. Belg. 134, 135, 136, 137, 138, 140, 141, 142, 143, 144, 145, 146, 147, 149, 172.

It has long been suspected that *rangiferina* and *sylvatica*, although classed together, were in reality two distinct species; and the different reaction in the two plants proves this suspicion to have good foundation.

The reaction (K+) separates this from *sylvatica, portentosa*, and *alpestris* (K−), and unites *pycnoclada* (K+) with it.

My herbarium has it also from Salzburg (Dr. Schwarz), Jerkin, Norway (Dr. W. L. Lindsay), Holm (Dr. Nylander), Bagni di Lucca (Dr. Deakin), and from Leicestershire (Rev. A. Bloxam), Glen Callater, Braemar (Dr. W. L. Lindsay).

Dr. Nylander says (*in litt.*) the *C. rangiferina* is decidedly a distinct species from *C. sylvatica*. That which M. l'Abbé Coëmans calls "*C. rangiferina*, var. *sylvatica* forma intermedia inter typum et var. *sylvaticam.*—*C. rangiferina*, *γ. tenuis*, *δ. fuscescens*, Flk. Comm. p. 165," and gives in his Cl. Belg. 149, is evidently a form of *rangiferina*, and exhibits the reaction K+.

2. *C. gorgonea*, Eschw. According to Dr. Nylander (*in litt.*) this has K+.

** *Phæocarpæ* (K—).

3. *C. sylvatica*, Hoffm. = Leight. Exs. 57; Richardson, 30, 33, 35; Massal. 192, 193; Welw. Lusit. 30; Schær. L. H. 78; Mudd, Br. L. 20; Br. Clad. 57, 59, 60; Bohl. 6; M. & N. 72; Anzi, C. C. 25 a (in part) b; Coëm. Clad. Belg. 129, 130, 131, 132, 133, 152, 153, 154, 155, 156, 157, 158, 159, 160, 161, 162, 163, 164, 165, 166, 167, 168, 169, 170, 171.

Of this in my herbarium are also specimens from Untersontheim (Kemler), Upsal (Dr. T. M. Fries), Salzburg (Dr. Schwarz), Lheris (Dr. Philippe), Algeria (Durieu), Jerkin, Norway (Dr. W. L. Lindsay), Leicestershire (Rev. A. Bloxam), Yorkshire (Mr. G. Dixon), Blaebery Hill, Perth (Dr. W. L. Lindsay), Basingstoke (Mr. R. S. Hill), Forfarshire (Rev. T. B. Bell), and Shropshire.

Some of the above specimens exhibit a slightly fuscescent reaction; nevertheless none of them have the decided yellow

reaction (K+) which satisfactorily distinguishes the true *rangiferina* from all the other plants which have hitherto been confounded with it. See remarks under *rangiferina,* anteà.

f. *alpestris,* Schær. (Dill. t. xvi. f. 29 E, F) = Anzi, C. C. 25 D; Fellm. 39; Krbr. 272; Schær. 79; M. & N. 1063; Richardson, 34; Coëm. Cl. Belg. 155.

Of this state my herbarium comprises specimens also from Kroten (Dr. Harslingsky), Tatra, Hungary (Dr. Holzinger), Jamaica (Dr. J. D. Hooker), Northern Island, Australia (Sinclair), Jerkin, Norway (Dr. W. L. Lindsay), Balliton, Kildare (Mr. I. Carroll).

f. *pumila,* Ach. = Anzi, C. C. 25 c; Coëm. Clad. Belg. 150, 151.

Of this also my herbarium contains specimens from Leicestershire and Shropshire.

f. *portentosa,* Duf. = Coëm. Clad. Belg. 165.

This very remarkable form also I have from Leicestershire (Rev. A. Bloxam).

4. *C. peltasta,* Spr. = Spruce, Amaz. 25.

5. *C. Salzmanni* (Dél.). According to Dr. Nylander (*in litt.*), this has K—.

6. *C. divaricata,* Nyl. According to Dr. Nylander (*in litt.*), this has K—.

7. *C. uncialis,* Hoffm. (E. Bot. t. 174) = Leight. Exs. 58; Fellm. 40; Anzi, C. C. 26; Schær. 82, 83, 84, 513, 514; Tuck. 34, 35; M. & N. 165; Coëm. 1039; Massal. 69; Bohl. 15, 31; Mudd, Br. L. 21, Br. Clad. 61, 62, 63, 64; Coëm. Clad. Belg. 120, 121, 122, 123, 124, 125, 126, 127, 128.

My herbarium comprises also specimens from Upsal (Dr. T. M. Fries), Saeblen (Dr. Philippe), Tatra, Hungary (Dr. Harslingsky), Arschot, Belgium (Abbé Coëmans), Jerkin, Norway, 4595 ft. (Dr. W. L. Lindsay), Austria (Dr. Holzinger), Vosges (Dr. C. Montagne), Basingstoke, Kent (Mr. R. S. Hill), Yorkshire (Mr. G. Dixon), Crookham Common, Hants (Mr. R. S. Hill), Ben Mac Dhu, Braemar (Dr. W. L. Lindsay), Kildonery and Coachford, co. Cork, and Doneraile Mountains (Mr. I. Carroll), Leicestershire (Rev. A. Bloxam), Blaebery Hill, Perth, Ben Nevis, 4406 ft. (Dr. W. L. Lindsay), and Barmouth, North Wales and Shropshire.

Var. *lacunosa,* Nyl. (Syn. i. 215) = Tuck. Am. Sept. 36.

Var. *amaurocræa,* Schær. (Nyl. Syn. i. 216) = Anzi, C. C. 11; Fr. L. S. 347; Fellm. 41, 42; Schær. L. H. 70. 272, 273; Richardson, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46.

I have also specimens from Upsal (Dr. W. Nylander and Dr. T. M. Fries), Jerkin, Norway, 4594 ft. (Dr. W. L. Lindsay).

Dr. Nylander regards *amaurocræa* as only a variety of *uncialis.*

8. *C. medusina,* Bory = Spruce, Amaz. 19, 20, 21, 22, 23, 24.

9. *C. schizopora,* Nyl. According to Dr. Nylander (*in litt.*), this has K—.

10. *C. aggregata,* Eschw.=Spruce, Amaz. 18.

Of this fine species my herbarium contains specimens from Middle Island and Port Nicholson (Dr. Lyall), Australasia (Dr. C. Knight), St. Patrick's River, Australia (Colenso), Pavianskloof, South Africa (Breutel), Valparaiso (Dr. Puccio).

11. *C. retipora,* Flk. Of this beautiful species I have specimens from Tasmania, Australia, Mount Wellington, Van Diemen's Land.

*** *Erythrocarpæ* (K—).

12. *C. leporina,* Fr.=Wright, Cuba, 44.

Of this Dr. Nylander (*in litt.*) says that it is a *Cladina,* Nyl.

IV. Pilophoron, Tuck.

1. *P. robustum,* Th., Fr. (Ster. Pil. t. 10. f. 3)=T. M. Fries, L. Scand. 11.

This has the reaction K+.

2. *P. aciculare,* Tuck. (Ach. Meth. t. 8. f. 4; Th. Fr. Ster. Pil. t. 10. f. 4).

The only specimens I have seen of this were collected by Dr. Lyall in Sumass, British Columbia, 1859, and have K+.

3. *P. fibula,* Tuck. Of this I have seen no specimens; but Dr. Nylander says it has K+.

V. Heterodea, Nyl.

1. *H. Mullerii,* Nyl. (Lich. Nov. Caled. p. 39) has K—.

Of the following *Cladoniæ,* described in Dr. Nylander's Synopsis, I have seen no specimens, and am also ignorant of their reaction:—

Phæocarpæ.

C. stenophylla, Nyl., *C. candelabrum,* Bory, *C. Caroliniana,* Tuck.

Erythrocarpæ.

C. leptopoda, Nyl., *C. areolata,* Nyl., *C. angustata,* Nyl., *C. cristatella,* Tuck., *C. macilenta* var. *seductrix,* Nyl.

LIV.—*On* Ophiodes, *a new Genus of* Hydroida. By the Rev. Thomas Hincks, B.A.

[Plate XIV.]

While dredging this autumn in Swanage Bay, on the coast of Dorset, I have obtained a new Sertularian Hydroid, which offers some very interesting peculiarities. Of these the most remarkable is the presence of an organ which takes the place of the nematophore, but is unique in appearance and structure. The polypite, too, differs in form from that of any other Hydroid with which I am acquainted, and is furnished with webbed tentacles—a character which has only been noticed hitherto among the *Campanularida*.

This very curious Zoophyte must be referred to a new genus, to which I shall assign the name *Ophiodes*. It may be thus characterized:—

Subkingdom *CŒLENTERATA*.

Class *HYDROZOA*.

Order **HYDROIDA**.

Suborder SERTULARIDA.

Family **Halecidæ**.

Ophiodes*, nov. gen.

Hydrocaulus simple or branched, rooted by a creeping stolon. *Hydrothecæ* vase-shaped, terminal; *polypites* not retractile within the calycle; the body deeply constricted a little below the base of the tentacles; tentacles in a single verticil, muricate, webbed for about a quarter of their length, and surrounding a conical proboscis; *tentaculoid organs* borne singly on the hydrocaulus (near the calycles) and on the stolon, highly extensile, protected at the base by a small chitinous cup, and terminated at the upper extremity by an enlarged capitulum, armed with thread-cells. Reproduction unknown.

The remarkable tentacular organ with which the *Ophiodes* is furnished, and which may be regarded as the equivalent of the nematophore, consists of a very extensile, snake-like appendage, with an enlarged head, attached at the lower extremity by an extension of the cœnosarc. The base is protected by a small chitinous tube, which expands from its point of origin upwards, and answers to the theca of the ordinary nematophore. The capitulum contains numerous thread-cells, from which a barbed sheath and a very long thread are emitted.

* Der. ὀφιώδης, snake-bearer.

These organs are capable of great elongation and contraction, and execute the most vigorous movements, stretching themselves out with apparent eagerness, and twisting in all directions. My attention was first drawn to the zoophyte by a number of them, disposed on the creeping stolon, which were in a state of most lively excitement, and manifesting a large amount of muscular energy.

One of these organs is almost always attached to the hydrocaulus a little below the calycle, and when in a state of extension it rises above it; and as it twists itself about, with its formidable armature ready for instant action, it has all the appearance of a purveyor to the polypite. Many of them are also distributed upon the hydrorhiza.

A striking feature of the genus *Ophiodes* is the constriction of the body of the polypite, dividing it into two well-marked regions—the *oral*, including the mouth and the tentacular circle and a kind of quasi pharynx, and the *aboral*, traversed by the digestive cavity.

The polypite does not extend to the bottom of the hydrotheca, but rests on a membranous diaphragm that shuts off the upper third of it and forms a cup-shaped chamber. This diaphragm is perforated in the centre, and through the orifice the body is linked on to the cœnosarc, that traverses the lower portion of the calycle.

O. mirabilis, n. sp.

Hydrocaulus erect, slightly branched, rudely annulated at the base, and jointed at intervals throughout. *Hydrothecæ* in the form of a vase, bulging slightly immediately above the base; the sides incurved, expanding gradually towards the top, with an everted rim; a single *tentaculoid organ* on the stem a little below the calycle, and many distributed on the stolon; *polypites* tall, the inferior portion of the body clavate, the oral funnel-shaped; tentacles about fifteen, a brownish cluster of thread-cells between each pair on the connecting web. Reproductive organs unknown.

Height about $\frac{1}{10}$ of an inch.

The branching of the *Ophiodes mirabilis*, as I have seen it, is of the simplest kind, usually consisting of a single division of the stem. It may possibly attain a more luxuriant growth; but I have examined a considerable number of specimens, and have always found it to be either simple or furnished with one or two short branches.

The polypite, when fully extended, is a singularly beautiful object, imitating to some extent the form of a tall and graceful candelabrum. Only the base of the body is within the calycle.

Immediately below the constriction there is a slight tinge of yellowish colouring.

The web that unites the lower portions of the tentacles forms a rather deep cup round the proboscis, and is coloured by the batteries of thread-cells that occur between each pair of arms. These intertentacular thread-cells are similar to those which thickly cover the capitulum of the snake-like organs. They emit a very long thread, with a barbed sheath at its base. These slender filaments may be seen cast forth beyond the tentacles, and intermingling with them, and must constitute an effective auxiliary force for the capture of prey. The arms are held alternately elevated and depressed.

The chitinous tube that encloses the base of the tentaculoid appendages is small and somewhat trumpet-shaped.

The *Ophiodes*, it will be seen, combines a large number of interesting characters; and one or two of its most striking features are unique. It presents a really remarkable array of curious structures—the distinct funnel-shaped head crowning the tapering body, and itself crowned by the tentacular verticil with its battery of thread-cells at every embrasure, the elegant calycle, the strange snake-like organ near it, either resting motionless and sentinel-like or twisting vehemently about, bristling above at times with barbs, and casting abroad its fatal threads, and the number of similar organs below, twirling themselves about in the maddest fashion, as if to scare away any invaders.

Hab. On weed, dredged in shallow water (5–8 fathoms), Swanage Bay, Dorset. Not uncommon.

EXPLANATION OF PLATE XIV.

Figs. 1 & 2. *Ophiodes mirabilis*, Hincks, highly magnified.
Fig. 3. One of the tentaculoid organs.
Fig. 4. A portion of the tentacular circle, showing the connecting web with its clusters of thread-cells.
Fig. 5. A calycle, showing the cup-shaped chamber which encloses the base of the polypite.

BIBLIOGRAPHICAL NOTICE.

Annuario della Società dei Naturalisti in Modena. Anno I. Modena, Maggio 1866. 8vo, pp. 152, with 8 plates.

The political development of Italy is attended by a gradual and steady progress of science. Scientific publications have been until lately comparatively few in number; and such as have appeared have been more or less marked by some irregularity in the manner of their

publication, many being most difficult to obtain, and apparently reserved for private circulation. In consequence of the limited intercourse between Italian naturalists and those of other countries, the labours of the former have remained sometimes for years unknown to the latter. Among those who have been most influential in effecting a change in all this, we must mention Professor Canestrini of Modena. He started the 'Archivio per la Zoologia, l'Anatomia, e la Fisiologia,' a work by this time well known to most biologists, from the original and important articles contained in the four volumes which have as yet appeared. Among his numerous zoological and archæological memoirs, we would direct special attention to that on Italian Freshwater Fishes *, invaluable on account of the author's acquaintance with the literature, and critical discernment of species. There is now a Society of Naturalists of Modena, under the presidency of the same gentleman, which, by publishing the memoirs read at the meetings in an annual volume, promises to be a source of general benefit to science. The volume now before us contains the following memoirs:—

Prof. Canestrini.—Archæological objects from the Modenese district.

Prof. Generali.—On a case of Induration of a Bovine Fœtus.

Prof. Rondani.—On Hymenopterous Parasites of *Cecidomyia frumentaria*.

Prof. Salimbeni.—Practical hints on the Culture of the Silkworm.

Prof. Ragona.—On the "isæoric" Lines (*linee iseoriche,* from ἴσος, equal, and *αἰώρα,* oscillation) of the Italian Peninsula, and some other questions regarding the distribution of temperature in Italy.

Prof. Ghiselli.—New views on Madness of Dogs.

Dr. Boni.—Descriptions of objects of Art of high antiquity recently discovered in the Modenese district.

Prof. Generali.—On the Changes of Colour in the Blood of some Insects when exposed to Atmospheric Air.

Prof. Canestrini.—Catalogue of the Freshwater Fishes of Italy.

MISCELLANEOUS.

"CAPTURE OF A RARE FISH (*Ausonia Cuvieri*) AT FALMOUTH.

"To the Editor of the 'West Briton.'

"SIR,—It affords me great pleasure to be able to record the capture of another rare and interesting addition to the fauna of the British Isles. Yesterday, about noon, as some fishermen were scanning the bay with their glasses, carefully watching for the approach of pilchards, their attention was attracted to a strange commotion about low-water mark, between the Castle Point and Gyllyngvase. They at

* "Prospetto critico dei Pesce d' Acqua dolce d' Italia," Archiv. per la Zool. 1866, iv. pp. 47–187.

once proceeded to the spot, where to their astonishment they found a large fish, in about four feet of water, lashing away with its powerful tail, evidently intent on beating a hasty retreat. After an obstinate resistance, in which the men were half drowned, and one of them severely wounded, this strange visitor was secured, and brought with all dispatch into the Falmouth fish-market. Fortunately I was close at hand when sent for, and consequently had an excellent opportunity of making a minute examination of the creature while still alive. It measured 4 feet in length, and weighed over a hundredweight. It was without exception one of the most beautiful sights the eye could light upon, the whole surface of the body presenting the appearance of most highly polished silver, having a most brilliant coating of the richest scarlet. The silvery colour of the belly, as in the mackerel, &c., presented a variety of evanescent tints, which with the death of the fish totally disappeared. A month or so since, a scarlet and silver fish was taken at Gorranhaven and examined by Mr. Couch; but of this example I have never seen a detailed or authenticated report, consequently I am wholly at a loss to decide as to whether the two examples are identical or not. I am strongly of opinion that the fish captured here yesterday is no other than the scarlet and silver fish of the Mediterranean, although there is a strange discrepancy in the size of this and Mr. Couch's example. I have taken a sketch and also a minute description of the creature as it appeared whilst alive; so that I have no doubt whatever of being able in a day or two to assign it its legitimate place in our British fauna.

"Yours very truly,
"W. K. Bullmore, M.D."

"1 Stratton Place, Falmouth.
"Oct. 1, 1866."

[*To Dr. J. E. Gray, F.R.S. &c.*]

Dear Sir,—It will be a matter of interest to you, and perhaps of surprise, to be informed that another example of Cuvier's *Ausonia* has presented itself to us. It came among the rocks close to Falmouth, and, after a stout resistance, was safely landed. It is about the same size as the former example, and resembles the drawing I sent for comparison, but with some differences, mostly, however, as regards colour, which was a bright scarlet over silver, the dorsal, anal, and border of the tail blue. A coloured figure of it is in my possession, and the fish itself will be preserved at Penzance.

It seems not a little remarkable that two examples of so rare a fish should run themselves ashore, at places not distant from each other, within comparatively so short a time.

I am, dear Sir,
Yours truly,
Jonathan Couch.

Polperro, Oct. 6, 1866.

Additions to the Zoophytes of Devonshire.

To the Editors of the Annals and Magazine of Natural History.

GENTLEMEN,—I observe a notice from the Rev. T. Hincks in the 'Annals' for last month, respecting the finding of *Sertularia attenuata*, Hincks, in North Devon and Cornwall. Mr. Hincks must have forgotten that he had a specimen of mine, for twelve months at least, which was found on the south coast of Devon, and which was not returned to me in time for publication in my 'Catalogue of the Zoophytes of Devonshire.'

I must ask those gentlemen who kindly purchased my 'Catalogue' to add the South Coast to the geographical distribution of this species, and also to add to the freshwater species *Plumatella emarginata*, Allm., and *P. fruticosa*, Allm., both of which I met with in the river Clyst, Bishop's Clyst, September 5, 1866.

I am, Gentlemen,
Yours obediently,
EDWARD PARFITT.

Devon and Exeter Institution.
Oct. 6, 1866.

On the Use of the Genus Potamogale. By Dr. J. E. GRAY, F.R.S. &c.

Dr. Günther, in the 'Record of Zoological Literature,' 1865, vol. ii. p. 33, observes, "We fully agree with Dr. Gray as regards the principle on which he objects to the name *Potamogale*;" and then proceeds, "but since he has adopted the specific name of *velox*, given by Du Chaillu at the same time, and as in this case the generic and specific names refer to the same individual specimen, succeeding naturalists have no other choice but to recognize or to reject both alike."

The latter observation is incorrect, and, like several other remarks on mammalia and reptiles in the work, must have been made on a very imperfect recollection of the paper to which they refer. A very cursory inspection of Du Chaillu's paper in the Boston Society's Proceedings (which is copied in the paper commented on in the 'Annals,' vol. xvi. p. 426) would have shown Dr. Günther that the generic name of *Potamogale* and the specific one of *velox* do not rest on the same basis. The animal is described in the paper, with some details, under the name of *Cynogale velox*, quite sufficiently, especially when one has the type specimen to confirm the description, to establish the specific name of *velox*. In a note to this description, Du Chaillu observes that, on account of its African habitat and a difference in the shape and proportion of the tail, he thinks it may be the representative of another genus, for which "I proposed the name of *Potamogale*, preferring, however, to wait until I can procure the skull and skeleton;" so that the statement that "succeeding naturalists have no other choice but to recognize or to reject both alike" is a most erroneous one. I regret to have to make these observations; but a 'Record' is of little use unless it is prepared with care, so that naturalists can place confidence in its accuracy.

Note on West-African Species of Hemirhamphus. By Dr. A. Günther.

I have just observed that I omitted, in my account of *Hemirhamphus*, to mention the West-African species described and figured by Dr. Bleeker in "Poissons de la Côte de Guinée," Mém. Soc. Holl. Haarlem, 1862.

1. The species described by him (p. 118, tab. 21. fig. 2) as *H. vittatus* (Val.), and identified with *Esox brasiliensis* (Brown), is most probably the Linnean *Esox brasiliensis* (see Catal. Fish. vi. p. 270), but distinct from *H. vittatus* (Val.).

2. *Hemirhamphus guineensis*, n. sp., Blkr. p. 119, tab. 25. fig. 2, is identical with *H. vittatus* (Val.), Günth. Fish. vi. p. 269.

3. *Hemirhamphus Schlegelii*, Blkr. p. 120, tab. 25. fig. 1, is a very distinct species, to which I have, unfortunately, given another name, viz. *H. calabaricus* (Fish. vi. p. 266).

On the Organs of Secretion in the Hemiptera. By J. Künckel.

The most voluminous of the salivary glands are supported on the stomach, and occupy the whole upper part of the thoracic cavity, and extend into the abdomen. Each of them is divided into two parts by a constriction, and from this point the ejaculatory duct issues beneath. This duct divides at once into two branches, the largest of which runs almost directly to the head, passing beneath the œsophagus, where it approaches that of the opposite side. These ducts become fixed in a small cylindrical piece, of solid texture, and finally open by distinct orifices. The smaller branch descends into the abdomen, forming numerous sinuosities, and then ascends towards the head; on arriving in front of the œsophagus, being suddenly turned aside, it passes beneath a large coriaceous piece, which plays a great part in the movements of the parts of the mouth and in the acts of suction and deglutition.

The glands of the second pair, concealed beneath the principal glands, are formed each of a simple cæcal tube rolled upon itself and terminating at the outer angle of the coriaceous piece just mentioned.

The superior salivary apparatus contains a secreting membrane covered throughout with utricles of equal size. The anterior part, often inflated, looks as if it formed a reservoir for the hinder part, which is generally racemose; but this is not the case, as the histological constitution shows that the same functions are performed by both parts. The second salivary apparatus shows much analogy with the preceding in its structure, but its utricles are more scattered. The two glands of which it is formed are the seat of a special secretion, and not, as supposed by Léon Dufour, reservoirs for that of the superior glands. The salivary secretion, when introduced into plants, produced none of the effects ascribed to the attacks of Hemiptera.

The liquid is probably exclusively an agent in digestion ; it is alkaline, and renders reddened litmus-paper slightly blue.

The odorific apparatus, which has long been well known in the adult Pentatomites, is a sac situated at the base of the abdomen, and opening in the metathorax by two ostiola, at the level of the last pair of legs. In the larvæ and nymphæ this organ does not exist, and yet, like the perfect insects, they diffuse their peculiar odour. In the young individuals, from their hatching to the period of their last transformation, there are, in the upper part of the abdomen, below the skin, two glands presenting the same characters as the inferior gland of the adults. The presence of these organs is indicated upon the arches of the dorsal region by two shields ; and each of these shields presents two ostiola, through which the liquid is ejaculated. —*Comptes Rendus*, September 3, 1866, pp. 433–436.

Fossil Spider from the Coal-formation. By Dr. F. Rœmer.

Dr. Rœmer has described and figured, in the 'Jahrb. Min. of Leonhard & Geinitz,' 1866, p. 136, a very perfect specimen of a Spider from the Coal-formation of Upper Silesia. It is called the *Protolycosa anthracophila*, a name that implies a near relation in general habit to the modern Lycosa. The body is about an inch long. Appended to this paper is a notice of a specimen of *Arthropleura armata*, Jordan, from the Carboniferous beds of Zwickau, by Dr. Geinitz. The specimen is sufficient to show that the animal was a Crustacean ; it is evidently part of the carapace, and probably of a Decapod.—Silliman's *American Journal*, July 1866.

On the Course followed by a Fungous Mycelium in the living trunk of Acacia dealbata. By G. Gasparrini.

The author examined the trunk of a fine plant of *Acacia dealbata* which, when in full flower in the Botanic Garden at Naples, was broken at the level of the soil by a slight gust of wind. The heart of the wood, from the collar for $2\frac{1}{2}$ decimetres upwards, was found to be rotten and blackish, whilst the alburnum and bark were in good condition. A microscopic examination showed in the altered part a brownish, ramose, articulated mycelium. This mycelium was traced up into the branches as far as about 5 metres above the soil. It did not attack the medullary rays, or the pith, or the spiral fibres surrounding it, or the fibrous cells, but only the dotted ducts.

M. Gasparrini inquires how this mycelium could have introduced itself into the trunk of the *Acacia*. He refers to the observations made by him upon the radicles of various Liliaceæ, several of which, having lost their spongioles, were open to foreign bodies of extreme tenuity.

He thinks that the extremely minute filaments of the mycelium occurring in the soil surrounding the *Acacia* might penetrate by the opening of the fibrous filament of the centre of these radicles into the interior of the bush, and thus ascend even to the summit of the trunk.—*Bibl. Univ.* 1866, *Bull. Sci.* p. 168.

THE ANNALS

AND

MAGAZINE OF NATURAL HISTORY.

[THIRD SERIES.]

No. 108. DECEMBER 1866.

LV.—*On the Structure and Habits of* Anthophysa Mülleri, *Bory, one of the Sedentary Monadiform Protozoa.* By H. James-Clark, A.B., B.S.*

During the last five years, and more especially within the latter eighteen months, I have been engaged largely upon an investigation of the relations of the monadiform animalcules to the zoospores of the true *Algæ*; and of all the numerous instances of the former that I have more or less thoroughly studied I have never met with one which could be said to bear but very moderate resemblance to the latter: I refer to the true *Algæ*; I scarcely need add that I mean by this to except those doubtful forms which seem to be related to *Volvox* and *Gonium*, such as *Pandorina, Protococcus, Stephanosphæra, Chlamidococcus*, &c.

Those who have become accustomed to these creatures, and have learned to look upon them, through long years of patient study, as old and familiar friends, know well the value of using the best lenses that the opticians of the present day can afford, and never doubt for a moment the utter worthlessness of an opinion which is founded upon a few fitful glances through a so-called ordinary working microscope. There is no other group of animals which so essentially seems to need the prolonged devotion of a specialist as the Protozoa—and above all, the lower members of that grand division. To write a monograph upon any single one of these flagellate forms may seem like devoting a volume to the structure and phases of a dot in a sunbeam; but no good microscopist need be told that the optical instruments of the present day are no less efficient than was the scalpel in the hand of Cuvier when he displayed to the world the organization of the larger and more elevated animals which he found on the southern shores of France.

Moreover it is particularly desirable that elaborate investigations should be made, and unstinted minutiæ set forth in illus-

* From Silliman's American Journal for September, 1866.

trations and descriptions, because there are yet among zoologists those who suppose that there is so little in the organization of Protozoa that no tangible characters can be found by which they may be typified or assimilated in a group by themselves.

The taxonomic relations of the organs of the INFUSORIA FLAGELLATA have received so little attention from investigators, that there is no small difficulty, with our present knowledge of them, in tracing the typical plan which is so eminently exemplified among the CILIATA. I hope I shall be pardoned, therefore, if I attempt to give a strict topographical view of the positions of the various organs of one among the most lowly of the whole group of animalcules.

A considerable portion of the second volume of the great work of Messrs. Claparède and Lachmann, 'Etudes sur les Infusoires,' &c., is occupied by a discussion of the animality of certain doubtful forms of Monad-like Infusoria. The tests which these authors offer as determinatives of the zoological relations of the forms in question are, the possession by them of a contractile vesicle, and the introception of food. By means of either the one or the other of these criteria they succeed in satisfying themselves that the *Volvocina*, *Astasiæ* (*Euglenæ* included), and the *Dinobrya* are true animals; but in regard to other forms they are unable to decide. Among those which are left in the latter category, there is a singular infusorian which, as is usually supposed, was originally named *Epistylis vegetans* by Ehrenberg, and *Anthophysa Mülleri* by Bory de St. Vincent. Dujardin gives a scarcely recognizable figure of it in the atlas of his work on Infusoria, but very properly places it among the monadiform animalcules. This is done, however, upon its general resemblance to the latter (alike undetermined at that date as to their animal nature), and not because he had by direct observation decided it to be a genuine animal. The figures of Cohn ('Mikroskopische Algen und Pilze,' Nov. Acta Acad. Cæs. Leop. 1854, taf. xv. figs. 1–8) are not much better than those of Dujardin.

Habitat and general appearance.—I have been so fortunate as to determine the animality of *Anthophysa* by both of the tests above mentioned; and there rests not the least doubt in my mind that this infusorian is as truly a member of the zoological kingdom as any of the well-known Protozoa. I would state, for the information of those who are not acquainted with the habits of this animalcule, that it is quite common among the freshwater weeds. It may be most advantageously studied when it is attached to *Myriophyllum* or *Ceratophyllum*—a small piece of the tip of the filiform leaf of either (which seems to be covered by an irregular floccose deposit) usually affording abundant specimens.

Under a low magnifying-power this floccose matter appears to consist of clusters of very jagged, irregularly branching and contorted, semitransparent, intertwined stems, and projecting tapering and flexible twigs. Each of the tips of the latter sustains a single more or less globose mass of spindle-shaped bodies, which radiate from a common centre of attachment, and are kept in a constant agitation by the spasmodic jerks of a long, stout, usually rigid, arcuate filament, with which the free end of each one is endowed. The whole bristling mass revolves alternately from right to left and from left to right, whirling upon its slender pivot with such a degree of freedom that one might almost suspect that it merely rested upon it and had no truer adhesion to it than the juggler's top to the end of the *bâton* upon which it spins. The largest of these twirling groups contains as many as fifty fusiform bodies; but most frequently not more than half that number are grouped together, and from this they vary in decreasing quantities down to only one or two upon each filamentous twig. In the last instances the bodies are comparatively quiet, scarcely moving out of focus at each spasmodic twitch of the arcuate filament. On this account, and because they offer an unobstructed view, the latter are by far the most available as objects for the investigation of their internal organization.

The relationship of the individual monads to the whole colony must, however, be studied where they are more numerously congregated, since, as will be shown presently, each monad sustains a definite relation to every other one, and to the twig to which it is attached. The larger colonies are frequently to be found swimming freely, with a rolling motion similar to that with which *Volvox* progresses. As a natural concomitant to this fact, twigs are to be met with here and there which do not bear anything at their tips. The colonies seem to break away very easily; and on this account the specimens should not be lifted out of the water when transferring them to the watch-glass or whatever sort of observing-trough is used.

Form, &c.—The adult monads have a truncate fusiform shape, and are slightly but quite appreciably flattened on two opposite sides, so that in an end view they appear to be broadly oval transversely. The attached end tapers gradually to a point; and on this account it is difficult to determine where the body ends and the twig begins. All of the members of a group radiate from a common point of attachment, to which they adhere by their tapering filamentous ends. The free end is truncate; but one corner of it, as if in continuation of the line along which the opposite flattened sides meet, projects in the form of a rather blunt triangular beak. At the inner edge of the base of

this beak lies the mouth, to which the former (as frequent observation has proved) acts as a lip or prehensile organ when food is taken into the body. The prevailing tint is a more or less uniform light gamboge, without the least trace of an eye-spot of any colour.

A most singular uniformity prevails in the arrangement of the several members of a group. Each monad is attached to its mooring in such a position that its flattened sides lie parallelwise with those of its nearest neighbour; and the beak projects from that corner of the head which is most distant from the twig. To give a full idea of the peculiarity of this arrangement, it must be stated here that the rigid, arcuate, spasmodically twitching filament mentioned above is attached close to the mouth, and invariably curves away from the beak, and consequently always toward the pedicel of the colony. One is forcibly reminded by this of the systematic relation of some of the flowers of *Labiatæ*, with their stamens projecting far beyond the upper lip of the corolla. The globose heads of the *Menthæ* are particularly good examples for illustrating this similitude.

Prehensile organs.—The only motile organs which this animalcule possesses are preeminently prehensile in character; and their apparent appropriation to the office of propulsion, when a colony breaks loose from its attachment, I can scarcely doubt is an accidental one, inasmuch as the arcuate cilium continues its spasmodic twitching without any apparent deviation from its usual mode of action.

There are two cilia, of very unequal size, attached to the truncate end of the body. The larger one of these has already been mentioned casually, as a *rigid, arcuate filament.* It does not taper, but has a uniform thickness from base to tip, and is about half as long again as the body. It arises near the base of the triangular beak, but appears to be separated from the latter by the intervening mouth. When quiet it appears like a bristle, and projects in a line with the longer axis of the body—at the base bending slightly toward the beak, and then sweeping off in a moderate but distinct curve in the opposite direction, so that on the whole it presents a long drawn-out sigmoid flexure. The plane of this curve lies in strict parallelism with the plane of the greater diameter of the body; in fact it may be said to be a direct continuation of it. It does not appear to have the character of a *flagellum,* except when assisting the smaller cilium to convey the food to the mouth; and then it lays aside its rigid deportment and assumes all the flexibility and wavy vibration of the prehensile organ of an *Astasia.*

The smaller cilium is an excessively faint body, and almost defies the detective powers of the highest objectives. This is

partly due to its almost incessant activity; for when it is quiet, or nearly so (which happens when food is passing into the mouth), it becomes comparatively quite conspicuous under a one-eighth-of-an-inch objective. It is scarcely as long as the greater diameter of the truncate end of the body. It arises close to the base of the larger cilium; but whether on the right or left, or nearer or more distant from the mouth than the latter, cannot be said positively. Most frequently it was observed to be flexed in the same direction as its companion; and occasionally it seemed to be quite evident that it was attached nearer to the mouth than the latter. It is highly flexible, and vibrates with great rapidity in what appears to be a gyratory manner.

The mouth.—This organ is never visible except when food is passing through it. It then may be seen that it lies close to the beak, which acts as a sort of lip by curving over the introcepted particles as they pass into the body. The mouth is highly distensible, at times allowing particles as wide as two-thirds the greater diameter of the body to pass in without any apparent extra effort. It seems undeniable that it possesses discriminative powers in regard to the quality of its food. This one may readily judge of for himself, by seeing the unerring precision with which the particles of floating matter are thrown, by the spasmodic incurvature of the larger flagellum, against the mouth, where, if they are not swallowed, they are detained but for an instant by the smaller cilium, quickly adjudged to be worthless, and then thrown off with a twirl of the organ which held them in temporary abeyance. If, however, the captured morsel prove to be agreeable, the larger cilium assists the operations of the smaller one and the lip, by abruptly bending itself at its point of attachment and laying its basal part across the food and pressing it into the mouth, while the terminal portion is kept in a constant wavy vibration, and curved toward the posterior end of the body. This is usually done in three or four seconds; and then the cilia return to their usual positions, while the introcepted edible passes toward the centre of the body, and is there immediately enclosed in a digestive vacuole. For a while the food dances about in this vacuole with a very lively motion, but finally it subsides into quietude.

The contractile vesicle.—There is a twofold difficulty in discovering the presence of this organ. In the first place, it is comparatively quite small; and secondly, it pulsates so slowly that it is very rarely possible to see it contract twice in succession between any two of the abrupt lateral deviations of the body which the spasmodic twitching of the arcuate flagellum produces. On this account it has not been possible to determine the precise rate of its systole and diastole. It seems to contract

from three to four times a minute. It lies near the surface, about halfway between the two ends of the body, and nearly midway betwixt the two extremes of its greater diameter. At the completion of its *diastole* it has a circular outline, and appears like a clear colourless vesicle in the midst of the yellowish tissue of the body. Upon contraction it disappears and leaves no trace of its presence. The *systole* progresses slowly, as in *Anisonema* (*A. sulcata*, Duj.?, and *A.* nov. sp.), *Cyclidium* (*C.* nov. sp.), and *Phacus pleuronectes*, Duj., and in this respect contrasts strongly with the same process in *Heteromita fusiformis*, Jas.-Clk., *Astasia tricophora*, Clap., and *Cryptomonas* (*C.* nov. sp.), in which the last half of the systole is very abrupt and marked.

The stem.—In addition to what has already been said of the general appearance of this part of the organism, it may be added that the older and basal portions of the branches are flat, and have a distinct longitudinal irregular striation, to all appearance made up of the older, laterally agglutinated twigs. The youngest, terminal portions of the branches which, under the name of twigs, have been described in this paper as the immediate supporters of the colonies of monads, are evidently tubular. They appear to be as flexible as a spider's thread, and are usually quite irregular in outline, and in the calibre of the canal which permeates them. The wall of these tubular twigs is quite thick, and is alike rough on the exterior and interior faces. The substance within the tubes appears homogeneous, but whether it is solid or fluid could not be determined. The oldest part of the stems is of a reddish-brown colour; but as they taper off into branchlets they gradually assume a gamboge-colour, and finally terminate in scarcely coloured twigs.

Reproduction by fissigemmation is the only method of propagating individuals which I have observed. As a preliminary to this process the monad gradually loses its fusiform shape, assumes at first an oval contour, and finally becomes globular. During this transition, both of the prehensile cilia become much more conspicuous than usual, and the body developes a closely fitting hyaline envelope about it, thus passing into a sort of encysted state. The contractile vesicle, however, does not seem to cease its pulsations during this period, and moreover it becomes quite conspicuous. This arises mostly from the fact that the body is in a nearly quiet state, and allows the observer to obtain a prolonged and undisturbed view of it. Unfortunately the rate of the pulsations of this organ was not ascertained when the following observations were made, because the whole time was occupied in watching and drawing the various and rapidly changing phases of self-division.

After the body assumes a globular shape, as above mentioned,

both the larger and smaller cilium seems to be undergoing a change, and becomes indistinct in outline*. Presently two larger flagella burst upon the view, apparently by the longitudinal splitting of the previously single one of the same kind, and rapidly separate from each other by the broadening of the body, and leave between them the smaller cilium. The latter at this time appears much thicker than usual, and seems to be composed of two closely approximated parallel threads. By this time the contractile vesicle has also divided into two, which lie closely side by side.

At this moment the time noted in one series of observations was 2.30 P.M. By 2.35 P.M. the larger flagella had separated still further, and the smaller cilium had split into two very conspicuous filaments, as yet, however, attached to a common point of the body. From this time forth to the completion of the process of fissigemmation all of the cilia kept up a slow vibration, in which they undulated from base to tip with a sort of snake-like motion. By 2.45 P.M. the body had become quite appreciably broader than long, the contractile vesicles were widely separated, and the smaller cilia had left between them a considerable space, and each one had approximated quite near to the base of a larger flagellum. At 2.50 P.M. the body had become nearly twice as broad as long, and the space between the two pairs of cilia was nearly twice as great as in the last phase, and considerably depressed in the middle, so that the body had a broadly cordate outline. By 2.52 P.M. the posterior end of the body (at a point a little to one side of the spot where it was

* In a new freshwater genus (see note 2) of sedentary, monadiform Protozoa (possessing two contractile vesicles, and only the *sigmoid flagellum*, the latter arising within a deep bell-like flange or projecting rim which embraces the anterior end of the body) this arcuate filament disappears altogether, by a sort of withering down from tip to base, reminding one of the shrivelling of the end of a cotton thread in the flame of a lamp, preliminary to the commencement of the longitudinal fissigemmation of the body and its bell-like flange; and then the new flagellum of each resultant of self-division grows out in about twenty minutes.

[2] *Codosiga*: κώδων, a bell, σιγάω, to be silent. *C. pulcherrima*, n. sp. Body obliquely obovate, and tapering at its posterior end into a slender pedicel; truncate and abruptly constricted in front where the base of the bell meets the body. Sigmoid arcuate flagellum as long as the body and bell. The two contractile vesicles in the posterior third of the body; superficial, large, and quite conspicuous, each contracting, alternately with the other, once in about half a minute. Bodies attached, in groups of from two to eight, by their pedicels to the tip of a slender stem; erect or divergent, but not pendent. Mouth at the base of the flagellum, *i. e.* terminal. Anus near the mouth. No eye-spot. Bell slightly flaring; half again deeper than broad; fully as deep as the length of the body; highly contractile. Colour of the body (excepting the hyaline bell), pedicels, and stem deep yellow. Common on fresh-water weeds about Cambridge, U.S.

attached to the pedicel) was also slightly indented, so that in outline it presented a guitar-shaped figure, each rounded half of which bore a pair of unequal cilia, and contained a contractile vesicle. In one minute more the contraction had increased to such an extent that the body was divided about halfway through. By 2.54 P.M. the animal had a dumb-bell shape, and the pedicel was attached to one of the segments near the point of constriction. Still the process went on very rapidly, and by 2.55 P.M. the new bodies were widely separated, but still attached to each other by a mere thread. At 3 P.M. the body which was attached to the pedicel was left alone, and its companion swam away to seek a new attachment and build up its stem.

To the last moment the hyaline envelope remained about the segments, and in fact so long afterwards that time and circumstances did not allow me to ascertain its final disposition. I would remark, however, that when the ovate bodies of the half-grown monads are contracted temporarily into a globular shape, they appear identical (excepting that they lack the hyaline envelope) with these recently fissated forms. In all probability, therefore, the latter lose their envelope and assume the shape of the former.

As to the development of the stem, I think it quite certain that it grows out from the posterior end of the body. The best proof of this is, that I have frequently found a monad (especially in the condition of the one which I described above as breaking loose from its companion) nearly sessile upon a clean spot, and attached by a very short, faint, film-like thread. From this size upward I had no difficulty in finding abundant examples as gradually increasing in diameter as they did in length—thus furnishing a pretty strong evidence that the stem grows under the influence of its own innate powers, and is not, therefore, a deposit emanating from the body of the monad, except, perhaps, as far as it may be nourished by a fluid circulating within its hollow core.

LVI.—*On Two European* Argulidæ, *with Remarks on the Morphology of the* Argulidæ *and their Systematic Position, together with a Review of the Species of the Family at present known.* By T. Thorell.

[Concluded from p. 286.]

IV.

I shall now pass in review the species of Argulidæ hitherto known, although many of them are so incompletely described that it is not without difficulty that they can be determined.

The arrangement which I have adopted can therefore be only provisional, and is put forward merely with a view to draw attention, on the part of those who have opportunities for examining new or incompletely known Argulidæ, to the characters which have seemed to me the most important for the systematic arrangement of these animals. Excepting in the case of the three European species, which I have had occasion to examine myself, the diagnoses are compiled from the descriptions and figures of others. I shall first range the fifteen (or sixteen) known Argulids in the order which seems to me the most natural, and then briefly particularize each species separately.

BRANCHIURA.

Corpus depressum, capite in scutum magnum, postice plerumque bifidum dilatato; oculi compositi longe sejuncti. Antennæ breves; primi paris unco incurvo armatæ, cum maxillipedibus primi paris ad figendum aptæ; secundi paris simplices, articulis paucis (4–5). Os in siphonem productum, mandibulas et, si quæ adsunt, maxillas quoque includentem; maxillipedes fortissimi, anteriores plerumque cotyledones formantes. Truncus segmentis 4, distinctis; pedum paria 4, natatoriorum, biramium, appendicibus branchialibus carentium. Cauda non segmentata, plana, foliacea, respirationi inserviens, testes aut receptacula seminis includens. Metamorphosis incompleta.

Animalia in cute externa, in cavitate branchiali vel in branchiis piscium (et batrachiorum) parasitantia.

Fam. Argulidæ, Leach, cet. (*Argulina*, Kr., Burm., cet.). Character subordinis etiam familiæ unicæ.

Gen. I. Argulus, Müller (1785).

Monoculus, Linn., cet.; *Binoculus*, Geoffr., cet.; *Ozolus*, Latr.; *Agenor*, Risso.

Maxillipedes primi paris in adultis cotyledones formantes.

α. Pedes flagello carent. Stimulus ante siphonem adest. Sipho mandibulas et maxillas continet. (*Agenor*, Risso.)

1. *A. purpureus* (Risso).

?2. *A. giganteus*, Lucas.

β. Pedes parium 1^mi et 2^di flagello instructi. Stimulus adest. Sipho mandibulas et maxillas continet. (*Argulus*, Müll.)

3. *A. foliaceus* (Linn.).

4. *A. coregoni*, Thor.

?5. *A. pugettensis*, Dana.

6. *A. catostomi*, Dana et Herr.

γ. Pedes parium 1mi et 2di flagello instructi. Stimulus adest. Sipho mandibulas tantum includit. (*Camulus**, nob.)

7. *A. Nattereri*, Hell.

δ. Pedes parium 1mi et 2di flagello instructi. Stimulus nullus? Sipho?

8. *A. salmini*, Kr.
9. *A. chromidis*, Kr.
10. *A. funduli*, Kr.

?11. *A. alosæ*, Gould.

?12. *A. elongatus*, Hell.

Gen. II. Gyropeltis, Heller (1857).

Maxillipedes primi paris apice unco forti armati (cotyledonibus nullis). Pedes parium 1–3tii flagello instructi. Stimulus nullus. Sipho mandibulas tantum includit.

1. *G. longicauda*, Hell.
2. *G. doradis*, Corn.
3. *G. Kollari*, Hell.

[?4. *G. Lacordairei* (Aud.)]

I. Argulus, Müller.

1. *A. purpureus* (Risso).

See p. 158.

2. *A. giganteus*, Lucas.

Syn. *Argulus giganteus*, Lucas, Exploration scientifique de l'Algérie; Hist. Nat. d. Animaux Articulés, Première Partie : Crustacés, (1845) p. 83, pl. 8. fig. 9.

"*A.* ovatus, flavescens, subtiliter rubro punctatus; testa dilatatissima, membranacea, utrinque fusco-rubescente unilineata. Long. 11 millim., latit. 7 millim."

Hab. in Mari Mediterraneo, ad oras Africæ (Algeriæ), in *Rajæ* sp. inventus.

I have been obliged to present the above diagnosis as Lucas has given it: it is certainly accompanied by a sort of description, but from this we get no further knowledge respecting the animal. The description, which is taken from a dried specimen, is so defective that, were it not that the author expressly says that he observed "de chaque côté de la base du *bec*, un appendice gros et court terminé par une *ventouse* cupuliforme," we should hardly be able to recognize the animal as belonging to the Argulidæ. "Il ne me reste," says he, "de ce crustacé curieux que le test. . . . Les antennes n'existent plus, et les organes de la

* Nomen propr. mythol.

locomotion ainsi que l'abdomen étant en trop mauvais état pour que je puisse en décrire la forme, je n'en parlerai pas." By the word *bec* is probably meant the *sting*, not the mouth-tube. All further information respecting this animal is summed up as follows:—" Cette espèce est bien moins discoïdale que l'*A. foliaceus*.... Jaunâtre, la tête est grande, très-allongée, et paraît arrondie à ses parties antérieure et postérieure; elle est fortement sillonnée longitudinalement entre les yeux, et ceux-ci, qui sont noirs, affectent une forme discoïdale. Le test est très-dilaté, membraneux, transparent et *paraît postérieurement ne pas être dépassé par l'abdomen*; il est jaune, finement pointillé de rougeâtre, et parcouru longitudinalement, de chaque côté, par une ligne d'un brun rougeâtre."

Of more value than this description is the statement that the animal was procured " en mai sur une *Raie* qui avait été prise dans la rade d'Alger, entre le fort de l'Eau et le cap Matifou."

The figure gives no clearer idea of the characters of the animal than the description. I have placed it next to *A. purpureus* on the ground of the elongated form of the shield, and because, as would seem to be expressed above, it appears to stretch over and cover the tail, as in that species. Both occur, moreover, in the same sea.

3. *A. foliaceus* (Linn.).

SYN. *Monoculus foliaceus*, Linné, Syst. Nat. ed. 10, tom. i. (1758) p. 634.
Argulus Charon, Müller, Entomostraca, (1785) p. 723, tab. 20. figg. 1, 2 (larva).
—— *delphinus*, id. ibid. p. 123.
—— *foliaceus*, Jurine, Ann. du Mus. d'Hist. Nat. tome vii. (1806) p. 431, pl. 26. figg. 1–21; Milne-Edwards, Hist. Nat. d. Crustacés, iii. p. 444; Baird, British Entomostraca, p. 255, pl. 31. figg. 1, 2 *a–l*.

Scutum cephalicum subovatum, antice utrinque parum sinuatum, pedes omnes, ultimi paris exceptis, tegens; cauda ovata, longitudine circa $\frac{1}{4}$ reliqui corporis, vix usque ad medium incisa, laciniis apice rotundatis; stimulus longus; sipho subclavatus; art. primus antennarum secundi paris aculeo valido armatus; cotyledones parvi, diametro circiter $\frac{1}{9}$ corporis longitudinis æquantes; pecten plaga media oblongo-rotundata scabra, dentibusque 3 fortibus acutis; alii dentes 2 inter maxillipedes secundi paris adsunt.—Longit. 6–7 millim., latit. circa $3\frac{1}{2}$ millim. (♂ ♀).

Hab. in aquis dulcibus fere totius Europæ, in cute externa et in cavitate branchiali (?) piscium (*Gasterosteorum, Cyprini carpionis, Abramis bramæ*, Leucisci rutili, Tincæ vulgaris, Esocis lucii, Percæ fluviatilis, Salmonis truttæ*), et in larvis *Ranarum* parasitans.

For a more complete synonymy we would refer to the works

* According to Mag. Widegren.

of Milne-Edwards and Baird above cited. It is not impossible that, under the appellation *A. foliaceus,* two separate species have been confounded. The figures which Vogt * has given of this animal differ from the Swedish (and consequently from the genuine) form in having the tail much smaller and almost bent inwards laterally. Jurine and Baird represent the tail such as I have found it in my own specimens.

4. *A. coregoni,* Thor.

See page 162.

5. *A. pugettensis,* Dana.

Syn. *Argulus pugettensis,* Dana, United States' Exploring Expedition, Crustacea, (1853) ii. p. 1351, pl. 94. figg. 2 *a* et *b*.

Scutum cephalicum oblongum, ellipticum, pedes omnes tegens; cauda magna, oblonga, longitudine circa $\frac{2}{5}$ reliqui corporis, et latitudine $\frac{2}{5}$ latit. scuti fere æquans, usque ad medium incisa, laciniis subacuminatis; stimulus longus; sipho subclavatus; cotyledones sat magni, diametro $\frac{1}{6}$–$\frac{1}{7}$ corporis longitudinis æquantes; pectinis dentes 3 subconici; dentes 2 inter maxillipedes secundi paris adsunt.—Long. circa 17, latit. 10 millim. (♀?).

Hab. in America boreali (ad oras occid.: "Puget's Sound"). Hospitium ignotum.

This very scanty description contains nothing respecting the oral organs; but the accompanying figures, which seem to be good, and which present the animal both from the dorsal and ventral aspects, show so strong a likeness to the two species immediately preceding, that I have not hesitated to place it in the same subdivision of the genus with them. The tail is proportionally larger, and especially broader at the base, than in *A. coregoni.*

6. *A. catostomi,* Dana et Herr.

Syn. *Argulus catostomi,* Dana et Herrick, Silliman's Amer. Journ. (1837) xxxi. p. 297. figg. 1–11; Milne-Edwards, Hist. Nat. d. Crustacés, iii. p. 445.

Scutum cephalicum amplum, suborbiculatum, paullo latius quam longius, antice utrinque subsinuatum, pedes quoque ultimi paris ad partem tegens; cauda lata, rotundata, longitudine circa $\frac{1}{4}$ reliqui corporis, postice non usque ad medium incisa, laciniis late rotundatis; stimulus longus; sipho ovatus; cotyledones mediocres; pecten plaga media scabra subtriangula, dentibusque 3 late truncatis; inter maxillipedes secundi paris dentes nulli. Ramus inferior pedum primi paris articulis 3,

* *Loc. cit.*

quorum 2 ultimi brevissimi; flagella pedum verticula media prædita.—Long. circa 10, lat. 9 millim. (♀).

Hab. in America boreali (Connecticut, New Haven), in flumine Mill River, etiam ubi aqua marina æstu crescente aquæ dulci admiscetur. In cavitate branchiali et in ipsis branchiis *Catostomi* sp. (*C. bostoniensis*, Lesueur, aut *communis*, ejusd.) inventus.

7. *A. Nattereri*, Hell.

Syn. *Argulus Nattereri*, Heller, Sitzungsberichte d. Kais. Akad. d. Wissensch., Math.-Naturwissensch. Cl., (1857) xxv. p. 103, taf. 1. figg. 4–12; Kröyer, Naturhist. Tidskr. 3die Række, (1863) ii. pp. 97, 103, tab. 1. fig. 3 *a–d*.

Scutum cephalicum amplum, suborbiculatum, paullo latius quam longius, lobo frontali paullo prominenti, supra denticulis et setis scabrum, pedes omnes et basin caudæ tegens; cauda parum prominens, brevissima, longitudine circa $\frac{1}{10}$ reliqui corporis, transverse elliptica, vix usque ad medium incisa; sipho magnus, subclavatus; cotyledones magni, diametro fere $\frac{1}{3}$ longit. corporis æquantes; pectinis dentes 3 longi, subacuminati.—Longit. circa 12, lat. 13 millim. (♀).

Hab. in America meridionali (Brasilia): in branchiis et cute *Salmini* (*Hydrocyonis*) *brevidentis*, Cuv. (*Salmini Cuvieri*, Val.), inventus.

This well-marked species is fully described and figured both by Heller and Kröyer. The former has given special attention to the oral organs; and his description is more complete on this point than Kröyer's, which, however, is in other respects ampler and accompanied by better figures.

8. *A. salmini*, Kr.*

Syn. *Argulus salminei*, Kröyer, Naturhist. Tidskr. 3die Række, (1863) ii. pp. 89, 103, tab. 1. fig. 2 *a–c*.

Scutum cephalicum amplum, suborbiculatum, parum latius quam longius, lobo frontali lato, prominenti, pedes omnes, exceptis ultimi paris, tegens; cauda rotundata, paullo latior quam longior, fere ad tertiam longitudinis partem incisa, longit. $\frac{1}{6}$–$\frac{1}{7}$ reliqui corporis æquans; cotyledones magni, diametro circa $\frac{1}{4}$ totius corporis longitudinis æquantes; pectinis dentes truncati, latiores quam longiores.—Long. circa 13, lat. 11 millim. (♀).

Mas differt magnitudine plus duplo minore, scuto cephalico elliptico, cauda paullo longiore quam latiore.

Hab. in America meridionali (Brasilia, Minas Geraës), in branchiis *Salmini* sp. inventus.

Of both this and the two following species Kröyer has given

* Kröyer has *Salmineus, Argulus salminei*, which is probably a mistake.

exact and complete descriptions. It is only to be regretted that the oral organs have been neglected.

9. *A. chromidis*, Kr.

Syn. *Argulus chromidis*, Kröyer, Naturhist. Tidskr. 3die Række, (1863) ii. pp. 92, 102, tab. 1. fig. 2 *a–c*.

Scutum cephalicum breve, ad segmentum trunci tertium tantum pertinens, fere inverse ovatum, parum longius quam latius, lobo frontali angustius rotundato; cauda subovata, longit. $\frac{1}{3}$–$\frac{1}{4}$ reliqui corporis, paullo longior quam latior, postice vix ad tertiam longitudinis partem excisa, laciniis apice subrotundatis; cotyledones mediocres, diametro circa $\frac{1}{7}$ corporis longitudinis æquantes; dentes pectinis multo longiores quam latiores, medio acuto, lateralibus obtusis; ova non truncum tantum, sed totum fere scutum occupantia.—Longit. circa 6, latit. 4 millim. (♀).

Hab. in America centrali (Nicaragua), in branchiis *Chromidis* sp. ex lacu Nicaragua semel inventus.

10. *A. funduli*, Kr.

Syn. *Argulus funduli*, Kröyer, Naturhist. Tidskr. 3die Række, (1863) ii. pp. 94, 103, tab. 2. fig. 1 *a–e*.

Scutum cephalicum parvum, longitudine circa dimidii corporis, paullo latius quam longius, antice angustatum, stipitem pedum primi paris saltem tegens, dorso postice gibbo; cauda longa, dimidiam reliqui corporis longitudinem fere æquans, duplo circiter longior quam latior, postice profunde, at non usque ad medium incisa, laciniis apice rotundatis; cotyledones magni, diametro circa $\frac{1}{5}$ corporis longitudinis æquantes; art. primus maxillipedum secundi paris dentibus caret.—Long. circa 3, latit. versus 2 millim. (♂ ♀).

Hab. in America boreali (Louisiana, New Orleans), in cavitate branchiali *Funduli* sp. inventus.

11. *A. alosæ*, Gould.

Syn. *Argulus alosæ*, Gould, Report on the Invertebrata of Massachusetts, comprising the Mollusca, Crustacea, Annelida, and Radiata, (1841) p. 340.

Scutum cephalicum parvum, dimidio corpore paullo longius, inverse ovatum vel subcordatum, parum longius quam latius, stipitem pedum primi paris tegens; cauda longa, $\frac{1}{3}$ reliqui corporis longitudine superans, circiter duplo longior quam latior, usque ad basin fissa, laciniis subacuminatis; cotyledones mediocres; truncus angustus, pedes longi.—Longit. circa 13, latit. 6 millim. (♀ ?)

Hab. in America boreali (Massachusetts), in branchiis *Alosæ* sp. (*A. tyranni* Dekay?) semel inventus.

This extremely short and meagre description is accompanied by a coarse woodcut representing the animal from beneath, but in which we can distinguish neither antennæ, "sting," nor shape of the mouth-tube. There seem to be no comb-like teeth on the hinder foot-jaws. The tail is described in the following words:—"Then [on the abdomen] follow two short folia, covered by two others, each of them nearly as long and as broad as the exposed part of the abdomen." The species undoubtedly stands near *A. funduli*, but seems to be distinguished by a somewhat longer head-shield, a longer and more deeply cloven tail, with more pointed lobes and smaller sucking-cups. Whether the feet possess flagella (*gissel*) or not, is not to be learnt from either description or figures.

This *Argulus* is, according to Gould, found on the "Alewife," which he identifies with the European *Alosa vulgaris*. Probably the fish in question was an *Alosa tyrannus*, Dekay, which, according to Valenciennes *, is the Alewife of the United States.

In 'Silliman's Journal,' (1839) vol. xxxvi. p. 393, under the title "New Species of *Argulus*; notice from Dr. T. W. Harris," we find the following remarks:—"It may interest some of your readers to be informed of the discovery of another species of *Argulus* in this country. It was found in the gills of a herring caught upon Brighton Bridge, from Charles River, during the month of June last. It differs from *Argulus foliaceus* of Europe, and from the species described in a former number of your Journal, vol. xxxiv. p. 225†, in the size and form of the body and in the shortness of the legs. Having presented the specimen to Dr. A. A. Gould for description, I shall not attempt to anticipate him by giving a detailed account of its specific characters at this time."

It is undoubtedly *A. alosæ* which is here alluded to; for Gould says, with reference to this specimen, that it was presented to him by Dr. T. W. Harris, who found it on the branchiæ of the "Alewife," which fish in America, like the *Alosa vulgaris* with us, is often confounded under the general name of "herring" or "sill." Gould has described no other species of *Argulus*. That the species differs from *A. foliaceus* in the shortness of the legs, is a mistake. See the diagnosis.

12. *A. elongatus*, Hell.

SYN. *Argulus elongatus*, Heller, Sitzungsber. d. Kais. Akad. d. Wissensch., Math.-Naturwissensch. Cl., (1857) xxv. p. 106, taf. 3. figg. 1–4.

Scutum cephalicum minimum, longitudine trunci, inverse sub-

* Cuvier et Valenciennes, 'Histoire Naturelle des Poissons,' (1847) tom. xx. p. 421.

† This probably means vol. xxxi. p. 297, where *A. catostomi*, Dana, is

cordatum, postice parum sinuatum, non excisum, neque truncum nec pedes tegens; cauda circa $\frac{1}{5}$ longitudinis reliqui corporis æquans, profunde incisa, lobis sat longis, lanceolatis; cotyledones parvi; art. primus maxillipedum secundi paris dentibus caret.—Longit. 10 millim., latit. 6 millim. (♀).

Hab. in America meridionali (Brasilia). Hospitium ignotum.

Amongst all known species of Argulids this one has the head-shield least developed, and its appearance is therefore very different from that of the others. Heller's description is very brief, and leaves undetermined, as does also his figure, whether the animal has a sting (*gadd*), and whether its feet are provided with flagella or not.

Obs. Argulus armiger, Müll. (Entomostraca, p. 124) = *Monoculus armiger*, Slabber*, is no *Argulus*, but the larva of a Cirripede.

II. Gyropeltis, Heller.

1. *G. longicauda*, Hell.

Syn. *Gyropeltis longicauda*, Heller, Sitzungsberichte d. Kais. Akad. d. Wissensch., Math.-Naturwissensch. Cl., (1857) xxv. p. 191, taf. 1. figg. 1–19; Kröyer, Naturhist. Tidskr. 3die Række, (1863) ii. pp. 99, 103, tab. i. fig. 4 *a–e*.

Scutum cephalicum suborbiculare, amplum, omnes pedes tegens; cauda longissima, 1½–2-plo longior et duplo angustior quam scutum et reliquum corpus, fere usque ad basin in duas lacinias angustas, sensim lanceolato-acuminatas fissa; pectinis dentes 3 conici, acuti.—Longit. 28, latit. 11 millim. (♂ ♀).

Hab. in America meridionali (Brasilia), in branchiis *Salmini brevidentis* (Cuv.) inventus.

2. *G. doradis*, Corn.

Syn. *Gyropeltis doradis*, Cornalia, Mem. del R. Istit. Lombardo, (1860) viii. pp. 161, tab. 2. figg. 1–18.

Scutum cephalicum suborbiculare, pedes ultimi paris vix tegens; cauda sat longior, reliqui corporis dimidiam longitudinem circiter æquans, fere usque ad basin in duas lacinias angustas, sublanceolatas fissa; pectinis dentes 3 breves, acuti.—Longit. 22, latit. 11 millim. (♀).

Hab. in America æquinoctiali, in corpore *Doradis nigri* Valenc. inventus.

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described. That described in vol. xxxiv. p. 225 is a *Caligus* (*C. americanus*, Pickering & Dana), not an *Argulus*.

* Natuurkundige Verlustigingen, behelzende microscopische waarneemingen, &c. (1769), cited from P. L. St. Müller's German translation: Physikalische Belustigungen, &c. (1775) p. 19, tab. 6. fig. 1.

3. *G. Kollari*, Hell.

Syn. *Gyropeltis Kollari*, Heller, Sitzungsberichte d. Kais. Akad. d. Wissensch., Math.-Naturwissensch. Cl., (1857) xxv. p. 102, taf. 1. figg. 20, 21; taf. 2. figg. 1–3.

Scutum cephalicum inverse subcordatum, amplum, omnes pedes et basin caudæ tegens; cauda brevis, $\frac{1}{3}$–$\frac{1}{4}$ reliqui corporis longitudinis æquans, inverse rotundato-ovata, postice parum profunde incisa, laciniis brevibus obtusis; pectinis dentes 3 breves, obtusi.—Longit. 12, latit. 9 millim. (♀).

Hab. in America meridionali (Brasilia). Hospitium ignotum.

?4. *G. Lacordairei* (Aud.).

Syn. *Dolops Lacordairei*, Audouin, Annales de la Soc. Entomol. de France, sér. 1. t. vi. (1837), Bull. p. 13.

Long. plus 15 millim.

Hab. in America meridionali (Cayenne), in pisce *Aymara* dicto parasitans.

Concerning this animal we have the following remarks from the above-cited source:—

"M. Audouin présente deux individus d'un crustacé singulier, qui a beaucoup d'analogie avec l'Argule foliacé de Jurine, mais qui en diffère surtout par l'absence de ventouses aux pattes antérieures, et par sa taille, qui dépasse un centimètre et demi.

"Ce crustacé a été trouvé à Cayenne par M. Lacordaire; il est parasite sur un poisson nommé *Aymara*, dont la chair est très-estimée, et qui vit dans toutes les rivières. M. Audouin en donne la description et le regarde comme le type d'un nouveau genre, auquel il assigne le nom de *Dolops*. Il dédie cette espèce à M. Lacordaire:

"*Dolops Lacordairei*. Ce nouveau genre sera décrit en détail et figuré."

That this *Dolops Lacordairei* is a *Gyropeltis*, or at least stands very near this genus, may be regarded as certain. But although the name *Dolops* is older than *Gyropeltis*, it seems to me in every respect more desirable to retain the latter appellation, inasmuch as Audouin did not determine or clearly point out the characters on which he founds the genus *Dolops*. No description of the species has, as far as I can discover, been published.

As at the most sixteen species of the family Argulidæ are as yet known, and as this number will undoubtedly be considerably increased, it would be premature now to attempt to draw, from what is known of the localities of these species, any general conclusions as to the *geographical range* of the family. We may, however, suppose with Kröyer that the great *American continent*

is its proper habitat, since *three-fourths* of the species which belong to the genus *Argulus*, together with all the species of the genus *Gyropeltis*, are limited thereto. The greater number belong to the warm parts of that continent: only one species (*A. pugettensis*) is known from the west coast of (North) America. Of the four non-American species enumerated in our list, *Europe* has afforded *three*, and *Africa one* species (inhabiting the Mediterranean).

It is further of importance to note the relative numbers of the species which live in *fresh* and in *salt* water. We perceive at once that, *as in the other Branchiopoda*, the number of *freshwater forms* preponderates. If we except the four species (*A. pugettensis, funduli*, and *elongatus*, with *Gyropeltis Kollari*) concerning which information in this respect is wanting, it will be seen that of the remaining species only *two* (*A. purpureus* and *giganteus*) are found on fishes which live exclusively in the sea; all the others are procured from fresh water. It would be of great importance to learn whether or not some of these freshwater forms can also live in salt water, and, in particular, whether the species (*A. coregoni* and *alosæ*, for instance) which live on fishes which undertake journeys from the sea up the rivers follow their hosts when these betake themselves again to the sea. We have already stated that *A. catostomi* lives also in the brackish water near the mouths of rivers.

In close connexion with the consideration that the larger number of the Argulidæ belong to lakes and rivers, and only a small portion to the sea, is the result which we obtain from an inquiry how they are distributed amongst the various groups of fishes. That the Argulids are not always (perhaps never) confined to a single sort of fish is shown in the case of the three European species, which live on fishes of different genera, even of widely separated families—especially *A. foliaceus*, the only Argulid of whose habitat and mode of life we have a tolerably satisfactory knowledge. This species not only attaches itself to freshwater fish of wholly different orders (Acanthopteri, Pharyngognathi, and Physostomi), but even attacks the larvæ of *frogs*, which is not known to be the case with any of the other species. We are ignorant as to the animals on which three of these (*A. pugettensis, A. elongatus*, and *G. Kollari*) occur. The rest have all been found on fishes, and, with the exception of a single species, on Teleostei or bony fishes. Of the other subclasses only one (viz. the *Selachia*) has figured in our list. *A. giganteus* is found upon a *Ray*. Amongst bony fishes it is, as we might almost conclude *à priori*, especially the order Physostomi which is affected by these parasites. A species of the Siluroid family barbours *G. doradis*; many Cyprinoids

are attacked by *A. foliaceus*, one by *A. catostomi*. Cyprinodonts have afforded *A. funduli*; the Characinidæ *A. Nattereri*, *A. salmini* and *G. longicauda*. Salmonoids are affected by *A. coregoni* and *A. foliaceus*, which has also been taken on an Esocoid; the Clupeidæ finally have contributed a species, *A. alosæ*. Among the Pharyngognathi the family Chromidæ has a parasite in *A. chromidis*; and among the Acanthopteri it is the families Scombridæ (for *A. purpureus* and *foliaceus*), Sparidæ (for *A. purpureus*), and Percidæ (for *A. foliaceus*) on which representatives of the Arguloid family have been hitherto observed.

I avail myself of this occasion to refute some objections which have lately been put forward by Claus* against the attempted arrangement of the order Copepoda communicated by me in my memoir above cited—"Contribution to our knowledge of the Crustacea which live on the species of the genus *Ascidia*, L."† This arrangement (in three parallel series, Gnathostoma, Pœcilostoma, and Siphonostoma) is based upon the structure of the organs of the mouth, which, he says "in the first division are adapted for chewing, in the other two for piercing and sucking. The arrangement of the free and parasitic in parallel series renders the formation of the subordinate groups more difficult, the three forms of mouth presenting numerous cases of transition. It separates nearly allied forms, and, if strictly adhered to, produces an unnatural and one-sided system. Further, the character imputed to the Pœcilostoma—'Os mandibulis et siphone carens, maxillarum paribus 3–1(–0) instructum'—rests on an error, since the mandibles are very well developed."

To begin with the last remark, which seems to contain a charge of especial weight, since it would appear that Claus represents me as overlooking in the Pœcilostoma the presence of the very organs (the mandibles) on the presence or absence of which the differences between the Gnathostoma and Pœcilostoma depend. That such, however, is not his meaning, is apparent from an expression on p. 28, where we read, "Here [in the Corycæidæ] the maxillæ are reduced to very simple plates furnished with several bristles, and have been regarded by Thorell as appendages of the mandibles." In effect the differences between Claus's and my notions of the oral organs of the Pœcilostoma reduce themselves

* Die frei lebenden Copepoden, p. 9.

† Prof. Kröyer (Bidrag til Kundskab om Snyltekrebsene, p. 82) also, but more summarily, attacks this attempt. As, however, he brings forward no sufficient objection, either against the principle adopted or the mode of its application, but rather confines himself to bitter invectives against those zoologists who, not troubling themselves with "mere descriptive work," are yet bold enough to "put forward systems," I shall treat his criticisms as they deserve.

to the circumstance that what he calls mandibles I regard as maxillæ, and his maxillæ are, according to my view, the appendages of the maxillæ, maxillary palpi. The reasons on which I base my view are the following:—First and foremost, the organs in question are sometimes *fused together*, as in the genera *Corycæus* and *Lichomolgus*; and it is more especially apparent in the last genus that the posterior ones are nothing more than appendages of the anterior ones, from the fact that they are not directed towards the opening of the mouth, but have their free border turned *backwards*. Now, since I know of no example in the Copepoda of the maxillæ taking the form of mandibular appendages, but several (among the parasitic forms) in which the palp separates itself from its union with mandible or maxilla, I have thought this sufficient reason for the supposition that the organs mentioned belong to the *same* pair. That I explain them as *maxillæ*, and consequently regard the mandibles as wanting, not the opposite, depends partly on the fact that they are situated further backwards than the mandibles of the Gnathostoma, partly and principally on the circumstance that I have found in two species of the genus *Lichomolgus*, precisely in the position occupied in the Siphonostoma by the proboscis with its enclosed mandibles, a half-rostrum, which I conceive should be regarded as a *rudimentary sucking-tube*. Were Claus's view correct, it would follow that "the mandibles" in the Copepoda in question must always want the mandibular palpi, and the "maxillæ" similarly always be without maxillary palpi. On the other hand, there is no lack of instances among the lower Crustacea of the absence of the mandibles. Among the Ostracoda the mandible is represented in *Cypridina* by an appendage on the maxilla, and is altogether wanting in *Philomedes*. In the Copepoda I will only recall (to say nothing of the parasitic forms) the genera *Sapphirinella*, Claus, which for oral organs possesses only a pair of maxillary feet, and *Monstrilla*, Dana, which wants *all* the oral appendages.

I have not been able to find, either among the forms known to me from autopsy or representations, any instance of actual *transition* between the oral organs of the Gnathostoma and Pœcilostoma. Certainly, in the genera *Candace*, Dana, and *Hemicalanus*, Claus, the mandibles, in their longer and slenderer shape, and in offering only two teeth at the extremity, differ not a little from the usual form of the mandibles in the Gnathostomous series; and it is probable that they are used more as piercing- than as chewing-organs. But the presence of a strong two-branched *maxillary palp*, besides separate many-lobed maxillæ of the usual nature, shows at once that this genus cannot be referred to the Pœcilostoma, but is essentially Gnathostomous.

Neither am I acquainted with any transition between the Pœcilostoma and Siphonostoma. It is freely granted that, in such forms as lack the appendages of the mouth, it may be sometimes difficult to determine to which series they should be referred; but in such instances correspondences in other parts of the general structure must decide the question: for example, it is easy to see that *Monstrilla* is a Pœcilostome and approaches the Corycæidæ, to which family it is, indeed, referred by Claus.

From what has now been said, it follows that I cannot admit that my arrangement of the Copepoda renders difficult the formation of subordinate groups, families, and genera. On the other hand, it is conceded that it sometimes removes from each other forms which in habitus stand tolerably near together; but this inconvenience is in a great measure compensated by the *parallelism* of the series. Certain it is that by the division of the Copepoda into *Copepoda carcinoidea* and *C. parasitica*, adopted by Claus, this inconvenience is not avoided: any definite limitation of these two groups based upon characters drawn from the form is not to be thought of. Claus himself admits this, but consoles himself with the consideration that the impossibility of a sharp definition of limits lies in the very nature of any system which would be true to nature. Many, however, will be found who will agree with me in not resting content with such reasoning, but in regarding fixed principles for the forming of divisions as necessary for any systematic arrangement. And if the source of such division be sought in the modifications of organs which are constant in their nature and significance throughout the entire life of the animal, which has seemed to me to be the case with the oral organs, a sharp definition of the limits of groups will not necessarily make the system one-sided and unnatural.

[*Note*. In a rather lengthy footnote appended to the preceding paper, Prof. Thorell makes the following important remarks relative to the nomenclature of the various portions of the body in the Argulids. Reverting to p. 150, we find that Prof. Thorell applies the terms *head* or *head-shield, trunk,* and *tail* to the principal divisions of the body in Argulids, calling the pieces attached posteriorly to the latter *appendages,* not *postabdomen.* In connexion with this he says:—

"Such a terminology differs somewhat from the now generally received division of the Crustacean body into *head, thorax, abdomen,* and *postabdomen.* There are several objections to this division. *Thorax* and *abdomen* are divisions founded (throughout the greater portion of the Articulate series) on notions almost exclusively drawn from the class of Insects, and are not properly applicable to any but that class and the Arachnids, where they

correspond to distinct sections of the bodily functions. This is not the case in either Myriopods or Crustaceans, where, however, the *head* is distinctly separated from the *trunk*; and, in Crustaceans at least (as in the Scorpions), the hindmost segment of the trunk is usually distinct, both in form and function, from the others, thus forming a *tail* or postabdomen so called. With the first three segments of the trunk, corresponding to the thorax of insects, this, however, is by no means the case; consequently the term 'thorax' seems quite inapplicable, since there is really no definite division of the body to apply it to; and with the rejection of the appellation 'thorax,' the terms 'abdomen' and 'postabdomen' also must necessarily be laid aside.

"The anterior segments of the trunk, on the contrary, show here, as in the Myriopods, a strong tendency to coalesce with the genuine head, and their extremities are thus most generally metamorphosed into organs used for chewing or holding food, i. e. *foot-jaws*. Either it is only *one* such segment which thus loses its own independent character, and becomes tributary to the head (Edriophthalma), or it is *two*, unless both pairs of foot-jaws belong to the same segment, as in Copepoda and Argulidæ, or *all three* of the so-called thoracic segments (Decapoda). Sometimes these segments, with their appendages, become more or less rudimentary, or would seem to disappear altogether, as in the Branchiopoda. (In the Squillidæ all the first five segments of the trunk are subordinate to the head.) In all these cases it seems better to call any anterior division of the body, however formed by such fusion of one, two, or three posterior segments, *head*. In the Decapoda, where three segments are united with the head, the term *cephalothorax* is perhaps a suitable one, if not that of *cephalocormus*, which I would apply to designate the complete fusion of the whole trunk with the head as a single piece. There is, however, even better reason for using 'cephalothorax' in connexion with the Argulids and many of the parasitic Copepods, as the *Caligidæ*, where the extremities or "foot-jaws" which have become coalescent with the head are not accessory oral organs, but genuine fixing- or seizing-organs. It should, however, be observed that every possible transition is found between such fixing-organs and the ordinary foot-jaws, and that only *one*, or at most two, segments of the trunk can be regarded as entering into the composition of any such cephalothorax.

"Often, indeed, amongst the Copepoda one of the trunk-segments is united with the head and the foregoing ones; but in this case the extremities of the segment are always of the same form as those of the preceding trunk-segments, i. e. *swimming-feet*, not foot-jaws, and such a segment belongs consequently to

the same division of the body as those preceding it. It may even be taken as a rule that all the *lower* Crustaceans (Xiphura, Branchiopoda, Ostracoda, Copepoda, and Cirripedia) have typically *two* pairs of foot-jaws, never more, while the Malacostraca have either *three* pairs or only *one* pair,—and, further, that the former have only *one* pair of maxillæ, while the Decapoda and other Malacostraca have generally *two* pairs.

"Thus in order to obtain at the same time a uniform and practically useful terminology for the class Crustacea, it seems to me advisable to abolish in that group the utterly meaningless divisions *thorax* and *abdomen*, and to adopt those which I have now put forward, viz. *head, trunk,* and *tail.*"]

LVII.—*A List of Spiders captured in the South-east Region of Equatorial Africa; with Descriptions of such Species as appear to be new to Arachnologists.* By JOHN BLACKWALL, F.L.S.

MY friend Mr. Meade having transmitted to me for examination a second collection of spiders, made in the south-east region of equatorial Africa by the late Mr. Richard Thornton and Mr. Horace Waller, the result of my investigation of the specimens contained in it is given in the following list.

Tribe Octonoculina.

Family LYCOSIDÆ.

Genus CTENUS, Walck.

Ctenus vagus, n. sp.

Length of the female $1\frac{1}{4}$ inch; length of the cephalothorax $\frac{2}{3}$, breadth $\frac{1}{2}$; breadth of the abdomen $\frac{2}{5}$; length of an anterior leg $2\frac{1}{6}$; length of a leg of the third pair $1\frac{1}{2}$.

The eyes are disposed on the anterior part of the cephalothorax in three transverse rows; the two anterior ones, with the two intermediate ones of the four constituting the second row, describe a trapezoid whose shortest side is before; and each of the two eyes forming the posterior row, with a lateral one of the second row, is seated on a tubercle; the intermediate eyes of the second row are the largest, and the lateral ones, which are in a line with them, much the smallest of the eight. The cephalothorax is compressed before, truncated in front, rounded on the sides, which are depressed and marked with furrows converging towards a narrow indentation in the medial line of the posterior region; it is clothed with short brownish-yellow hairs, and is of a dark reddish-brown colour, with narrow, brown lateral margins. The falces are powerful, conical, vertical, and

armed with teeth on the inner surface; the maxillæ are straight, enlarged at the extremity, which is rounded on the outer side and obliquely truncated on the inner side, where it is supplied with long hairs; the lip is short, broad, and somewhat quadrate, but rounded on the sides; the sternum has a broad oval form, with small eminences on the sides, opposite to the legs. These parts are of a dark-brown colour, the falces, which are much the darkest, being supplied with red hairs at the base, in front. The legs are long, robust, provided with brownish-yellow hairs and strong sessile spines, and are of a red-brown colour; the first pair is the longest, then the fourth, and the third pair is the shortest; the metatarsi and tarsi have brown hair-like papillæ on their inferior surface, and the latter are terminated by two curved claws, pectinated at their base. The palpi are long, and rather lighter-coloured than the legs, with the exception of the digital joint, which has a brown hue. The abdomen is oviform, densely covered with brownish-yellow hairs, convex above, and projects a little over the base of the cephalothorax; a series of broad, curved, angular lines of a brown colour, having their convex sides towards each other and their vertices directed forwards, extends along the middle of the upper part; and on each side of it there is a row of four depressed dark-brown spots: the sexual organs, which are well developed, and of a red-brown colour, have a large process directed backwards from their anterior margin, whose extremity is dilated.

This large *Ctenus* was the only individual of the species included in the collection.

Genus Sphasus, Walck.

Sphasus pulchellus, n. sp.

Length of the female $\frac{1}{2}$ of an inch; length of the cephalothorax $\frac{3}{16}$, breadth $\frac{3}{20}$; breadth of the abdomen $\frac{5}{24}$; length of an anterior leg $\frac{5}{8}$; length of a leg of the third pair $\frac{9}{20}$.

The abdomen is oviform, somewhat pointed at the spinners, very convex above, and projects over the base of the cephalothorax; it is clothed with adpressed hairs, and is of a red-brown colour mingled with yellowish white; the under part, which is of a yellowish-white hue, has a dark-brown band extending along the middle; the sexual organs are moderately developed, with a longitudinal septum in the middle; they are of a dark red-brown colour, the posterior margin being much the palest, and that of the branchial opercula is brown. The eyes are disposed on the anterior part of the cephalothorax, high above the frontal margin; the four posterior ones form a greatly curved transverse row, whose convexity is directed upwards and somewhat backwards, and the other four describe a trapezoid whose

shortest side is before; the posterior eyes of the trapezoid are the largest, and the anterior ones are much the smallest of the eight. The cephalothorax is slightly compressed before, truncated in front, rounded on the sides, convex, glossy, with a slight indentation in the medial line; it is of a brown colour tinged with red, and has an irregular dark-brown band on each side, and a spot of the same hue behind the medial indentation; the space comprised between the posterior eyes of the trapezoid and those of the transverse curved row, and a spot on each exterior angle of the frontal margin, are of a dark-brown colour; the lateral margins and the front are provided with yellowish-white hairs, and some of a pale-red hue occur on the abruptly sloped base. The falces are powerful, subconical, vertical, supplied with dull-yellowish hairs in front, and armed with one or two minute teeth on the inner surface; the maxillæ are long, obliquely truncated at the extremity, on the outer side, and slightly inclined towards the lip, which is broader towards the extremity than at the base, and truncated at the apex; the sternum is heart-shaped, and clothed with short yellowish-white hairs intermixed with long ones of a darker hue. These parts are of a brown colour tinged with red. The legs are slender, provided with hairs and long spines, and are of a pale-brown hue, with a few annuli of a deeper shade; the first pair is the longest, then the second, and the third pair is the shortest; each tarsus is terminated by three claws; the two superior ones are curved and pectinated, and the inferior one is inflected near its base. The palpi, which are without annuli, resemble the legs in colour, and have a curved, pectinated claw at their extremity.

A single specimen of this species was included in the collection.

Family Ciniflonidæ.

Genus Orithyia, Blackw.

Orithyia Williamsii.

Orithyia Williamsii, Blackw. Ann. & Mag. Nat. Hist. ser. 3. vol. ii. p. 331, and vol. viii. p. 443.

The collection contained three females of this species. Both sexes of *Orithyia Williamsii* have been received from Pernambuco.

Genus Eresus, Walck.

Eresus africanus, n. sp.

Length of the female $\frac{13}{20}$ of an inch; length of the cephalothorax $\frac{5}{16}$, breadth $\frac{1}{5}$; breadth of the abdomen $\frac{5}{16}$; length of an anterior leg $\frac{3}{5}$; length of a leg of the third pair $\frac{3}{8}$.

The eyes are disposed on the anterior part of the cephalothorax;

a large quadrilateral figure, formed by the four exterior ones, whose anterior side is the longest, includes a small trapezoid described by the four intermediate ones; the posterior eyes of the trapezoid are the widest apart and the largest of the eight, and the anterior ones, each of which is seated on a small tubercle, form with the anterior eyes of the quadrilateral figure a transverse row in front. The cephalothorax is large, very convex in the cephalic region, depressed behind, clothed with brownish-yellow hairs, and of a red-brown colour, the lateral margins being the palest. The falces are short, powerful, cuneiform, vertical, densely covered with reddish-yellow hairs at the base, in front, and of a red-brown colour, the extremity being much the darkest. The maxillæ are straight, enlarged at the extremity, which is rounded on the outer side and somewhat produced on the inner side; the lip is triangular, and the sternum is oval. These parts have a pale red-brown hue. The legs are moderately long, robust, clothed with hairs, and are of a yellowish-brown colour, the under part of the femora and tibiæ of the first and second pairs having a dark-brown hue; the first pair is the longest, then the fourth, and the third pair is the shortest; each tarsus is terminated by three claws; the two superior ones are curved and pectinated, and the inferior one is inflected near its base, where there are several minute teeth; the metatarsus of each posterior leg is provided with a calamistrum. The palpi, which are short, resemble the legs in colour, and have a curved, pectinated claw at their extremity. The abdomen is oviform, convex above, projecting over the base of the cephalothorax; it is clothed with brownish-yellow hairs, and is of a yellowish-brown colour, the under part being much the brownest; four dark-brown depressions, connected by a sinuous line of the same hue, extend along each side of the medial line of the upper part: the sexual organs are moderately developed, and of a red-brown colour; the spinners are eight in number; those of the inferior pair, which are the shortest, consist of a single joint each, and are united throughout their entire length.

An adult and an immature female of *Eresus africanus* were included in the collection. This species is provided with eight spinners and calamistra; and I am informed by the Rev. O. P. Cambridge that Dr. Ludwig Koch, of Nürnberg, has observed that some other species of the genus are similarly organized. Should all of them be found to be provided with these parts, the entire genus should be comprised in the family *Ciniflonidæ*; but if they are possessed only by a portion of the species, a new genus, founded on such species, should be transferred to that family.

Family Salticidæ.

Genus Salticus, Latr.

Salticus cornutus, n. sp.

Length of the female (not including the spinners) $\frac{1}{3}$ of an inch; length of the cephalothorax $\frac{3}{20}$, breadth $\frac{1}{8}$; breadth of the abdomen $\frac{1}{8}$; length of a leg of the third pair $\frac{7}{24}$; length of a leg of the second pair $\frac{5}{24}$.

The cephalothorax is somewhat quadrate, but rounded on the sides; it is convex and glossy, but slopes abruptly at the base, and gradually to the front, which projects a little beyond the mandibles; it has a small indentation near the middle, and is provided with a few scattered black hairs, eight, longer than the rest and closely grouped, having the appearance of a slightly curved horn, situated near the minute intermediate eye of each lateral row on its outer side; the falces are short, subconical, and vertical; the maxillæ are straight, and enlarged and rounded at the extremity; the lip and sternum are oval, the latter being broader at its posterior than at its anterior extremity; the legs are robust, particularly those of the first and second pairs, and are provided with hairs and spines, two parallel rows of the latter occurring on the inferior surface of the tibiæ and metatarsi of the first and second pairs; the third pair is the longest, then the fourth, and the second pair is the shortest; each tarsus is terminated by two curved, slightly pectinated claws, below which there is a small scopula; the palpi are slender, and are supplied with numerous whitish hairs, especially on the digital joint. These parts are of a yellowish-brown colour, the sternum and palpi being the palest. The eyes are nearly encircled by short, coarse, white hairs; the lateral eyes are seated on tubercles placed on dark reddish-brown patches, the minute one of each row being nearer to the anterior than to the posterior eye of the same row. The abdomen is oviform, pointed at the spinners (which are prominent), densely clothed with hairs, moderately convex above, and projects over the base of the cephalothorax; the upper part is of a brownish-yellow colour tinged with red on its margins, the posterior margin forming a curve above the spinners whose convexity is directed forwards; a line composed of minute black spots borders each lateral margin of the upper part, and a band of the same hue, which is supplied with white hairs having a silvery lustre, extends along the middle; this band increases in breadth to its extremity, which is crescent-shaped; the sides and under part have a pale dull-yellow hue; the former are clothed with white hairs, and have a broad, irregular, brownish-black band extending along each, whose continuity is interrupted at its posterior extremity; a

short fine line in the middle of the under part, a rhomboidal spot near its extremity, and the superior pair of spinners have a dark-brown hue: the sexual organs are well developed, have a dull pale-yellow septum in the middle, and are of a red-brown colour.

Two females of this remarkable *Salticus* were comprised in the collection, one of which was adult, and the other immature. It appears to have a near relation of affinity to the *Attus bos* of Sundevall, 'Conspectus Arachnidum,' p. 27.

Family Thomisidæ.

Genus Thomisus, Walck.

Thomisus candidus, n. sp.

Length of the female $\frac{7}{16}$ of an inch; length of the cephalothorax $\frac{1}{6}$, breadth $\frac{1}{7}$; breadth of the abdomen $\frac{3}{10}$; length of a leg of the second pair $\frac{7}{16}$; length of a leg of the third pair $\frac{3}{10}$.

The abdomen is broad, oviform, somewhat pointed at the spinners, corrugated on the sides, glossy, convex above, projecting over the base of the cephalothorax, and has a white hue; a transverse line in front of the upper part, two transverse sinuous lines situated above the spinners, the anterior one being the longer, two spots on each side of the medial line, describing a large quadrilateral figure, whose shortest side is formed by the anterior pair, which are much the smallest, two spots on each side of the posterior extremity, the coccyx, and the upper surface of the two superior spinners are of a dark red-brown colour: the sexual organs, which are not highly developed, have a red-brown hue; and a row of minute, indented, pale-brown spots, on each side of the medial line of the under part, extends to the spinners, where the two meet. The eyes are disposed on the anterior part of the cephalothorax in two transverse, slightly curved rows, forming a crescent whose convexity is directed forwards; the eyes of each lateral pair are seated on white tubercles united at their base, the anterior one being the largest, and the two intermediate ones of the posterior row the smallest of the eight. The cephalothorax is slightly compressed before, truncated in front, rounded on the sides, very convex near the middle, depressed at the base, gradually sloped to the front, and glossy; the falces are strong, cuneiform, and vertical; the maxillæ are enlarged where the palpi are inserted, obliquely truncated at the extremity, on the outer side, and inclined towards the lip, which is triangular, but rounded at its apex; the sternum is heart-shaped; the legs are provided with a few spines; the first and second pairs are longer and more robust than the third and fourth pairs, the second pair rather surpass-

ing the first, and the third pair is the shortest; each tarsus is terminated by two curved, pectinated claws; the palpi are short, and have a curved, pectinated claw at their extremity. The colour of these parts is pale dull-yellow, the sternum being the palest; there is a minute brown spot near the base of the falces, in front, and their extremity is whitish; two small black spots occur on the under side of the femora of the first pair of legs, one near the base and the other near the extremity, and there is a black transverse streak, which does not form an annulus, at the extremity of the genual, tibial, and metatarsal joints of each leg.

Only one specimen of this pretty *Thomisus* was included in the collection.

Genus Olios, Walck.

Olios leucosius.

Olios leucosius, Walck. Hist. Nat. des Insect. Apt. tom. i. p. 566.
Thomisus venatorius, Latr. Gen. Crust. et Insect. tom. i. p. 114.

Numerous specimens of both sexes of this species, in various stages of growth, were comprised in the collection.

Genus Sparassus, Walck.

Sparassus abnormis, n. sp.

Length of an immature female $\frac{5}{16}$ of an inch; length of the cephalothorax $\frac{1}{8}$, breadth $\frac{1}{8}$; breadth of the abdomen $\frac{3}{20}$; length of a leg of the second pair $\frac{5}{8}$; length of a leg of the third pair $\frac{3}{8}$.

The legs are slender, provided with hairs and long spines, and are of a brownish-yellow hue; there are two minute black spots on the upper surface of the tibiæ, three on the metatarsi of the first and second pairs, and two on the metatarsi of the third and fourth pairs; the second pair is the longest, then the first, and the third pair is the shortest; each tarsus is terminated by a *single* slender, curved, pectinated claw, below which there is a small scopula. The eyes are seated on black spots, and are disposed on the anterior part of the cephalothorax in two transverse rows; the four anterior ones, which are the largest, form a straight row, situated near the frontal margin, and the other four constitute the posterior row, which is rather the longer and slightly curved, having its convexity directed backwards. The cephalothorax is compressed before, truncated in front, greatly rounded on the sides, convex in the middle, sloped to each extremity, with a narrow longitudinal indentation in the medial line of the posterior region, and is of a yellow-brown colour, the lateral margins being much the palest. The falces are powerful, conical, vertical, and armed with teeth on

the inner surface; the maxillæ are short, straight, and rounded at the extremity; the palpi are robust, and terminated by a fine minutely pectinated claw; the lip is semicircular; and the sternum is heart-shaped. These parts are of a yellowish-white colour, the base of the lip being tinged with brown, and the sternum with green. The abdomen is oviform, convex above, and projects over the base of the cephalothorax; it is of a pale-yellow colour, reticulated with pale brown, the under part being the least distinctly marked, and has a ramified band of a brown hue extending from the anterior extremity of the upper part about half its length.

This *Sparassus*, the only specimen of the genus in the collection, is especially remarkable for having only a *single claw* at the extremity of each tarsus.

Family Theridiidæ.

Genus Theridion, Walck.

Theridion trahax, n. sp.

Length of the female $\frac{3}{16}$ of an inch; length of the cephalothorax $\frac{1}{12}$, breadth $\frac{1}{12}$; breadth of the abdomen $\frac{1}{10}$; length of an anterior leg $\frac{1}{2}$; length of a leg of the third pair $\frac{3}{10}$.

The eyes are disposed on the anterior part of the cephalothorax in two transverse rows, high above the frontal margin; the four intermediate ones nearly form a square, the two anterior ones (which are placed on a slight protuberance, and are rather nearer to each other than the two posterior ones) being the darkest-coloured of the eight; the eyes of each lateral pair are seated on a tubercle, and are contiguous. The cephalothorax is compressed before, rounded on the sides, convex, glossy, with an indentation in the medial line of the posterior region; the falces are conical and vertical; the maxillæ are obliquely truncated at the extremity, on the outer side, and inclined towards the lip, which is semicircular; the sternum is heart-shaped, pointed at its posterior extremity, and has small eminences on the sides, opposite to the legs; the legs are long, and provided with hairs; the first pair is the longest, then the fourth, and the third pair is the shortest; each tarsus is terminated by three claws; the two superior ones are curved and pectinated, and the inferior one is inflected near its base; the palpi are short, and have a curved, pectinated claw at their extremity. These parts are of a brownish-red colour; the extremity and inner margin of the maxillæ and the apex of the lip have a yellowish-white hue, and the digital joint of the palpi is tinged with brown. The abdomen is oviform, clothed with longish scattered hairs, convex above, and projects over the base of the cephalothorax;

it is of a dull-brown colour, the sides and under part being the palest, and has two irregular yellowish-white spots on each side of its posterior half, and three others of the same hue disposed in a longitudinal row above the spinners: the sexual organs are well developed, rather prominent, and of a dark reddish-brown colour, that of the spinners being pale brown.

The only specimen of this species comprised in the collection was an adult female.

Genus Pholcus, Walck.

Pholcus pallidus.

Pholcus pallidus, Blackw. Ann. & Mag. Nat. Hist. ser. 3. vol. i. p. 433, and vol. viii. p. 444.

A single female of this species was included in the collection. Both sexes of *Pholcus pallidus* have been received from Pernambuco.

Genus Artema, Walck.

Artema convexa.

Artema convexa, Blackw., Ann. & Mag. Nat. Hist. ser. 3. vol. ii. p. 332.

Length of the female $\frac{3}{8}$ of an inch; length of the cephalothorax $\frac{1}{6}$, breadth $\frac{1}{6}$; breadth of the abdomen $\frac{1}{6}$; length of an anterior leg $2\frac{5}{10}$; length of a leg of the third pair $1\frac{7}{12}$.

The sexes are similar in colour; but the male, though the smaller, has longer legs, an anterior one measuring $2\frac{7}{10}$ inches. The falces are short and irregular in figure, being hollowed on the inner side, and having a strongly arched, tuberculated, dark-brown ridge in front, which terminates in a point; below the ridge they are of a brownish-red hue, and their extremity is armed with a short, slightly curved fang, and a single, pointed tooth on the inner surface. The palpi are glossy, very robust, and their prevailing colour is brownish-yellow, the axillary joint, the base and extremity of the humeral joint, the remarkably short cubital joint, the inferior surface and extremity of the radial joint, and the entire digital joint having a dark-brown hue tinged with red; the axillary joint is short, and produced at its extremity, on the under side; the humeral joint is greatly dilated, convex on the upper side, with a pointed protuberance at its base, on the outer side; the radial joint is nearly hemispherical; and the digital joint is small, with a large apophysis on its outer side of a dark-brown colour tinged with red; this apophysis has a prominent process near its base, on the upper side, and its broad, somewhat depressed extremity is irregular in form; the palpal organs, which are connected with the inferior surface of the digital joint, are subglobose, glossy, of a brownish-yellow hue, and project from their outer side a large curved

process having a short pointed spine in contact with its base, on the inner side, and have a strong obtuse process in front; these processes and the spine are of a dark-brown colour tinged with red.

The large brown-black spots in the medial line of the upper part of the abdomen of both sexes are commonly bisected, and form two distinct longitudinal rows.

Adult and immature females and an adult and immature male of this species were comprised in the collection. Adult females and an immature male of *Artema convexa* have been received from Pernambuco. On a comparison of the dimensions of females from Africa and South America, the African specimens will be found to be somewhat the larger, and to have longer legs.

Family Linyphiidæ.

Genus Linyphia, Latr.

Linyphia lepida, n. sp.

Length of an immature female $\frac{1}{10}$ of an inch; length of the cephalothorax $\frac{1}{20}$, breadth $\frac{1}{24}$; breadth of the abdomen $\frac{1}{20}$; length of an anterior leg $\frac{1}{4}$; length of a leg of the third pair $\frac{1}{8}$.

The cephalothorax is slightly compressed before, rounded in front and on the sides, convex, glossy, with an indentation in the medial line of the posterior region; it is of a brownish-yellow colour, with a broad brown band extending from each lateral pair of eyes nearly to its base. The eyes, which are seated on black spots, are disposed on the anterior part of the cephalothorax in two transverse rows; the four intermediate ones form a square, the two anterior ones being rather the largest of the eight; and those of each lateral pair are placed obliquely on a small tubercle, and are near to each other, but not in contact. The falces are conical, vertical, armed with a few teeth on the inner surface, and of a brownish-yellow hue, the extremity being the darkest. The maxillæ are somewhat quadrate, having the exterior angle, at the extremity, curvilinear; the lip is semicircular, and slightly pointed at the apex; and the sternum is heart-shaped. These parts are of a dark-brown colour, the extremity and inner margin of the maxillæ, the apex of the lip, and a broad band in the middle of the sternum, which is pointed at its posterior extremity, having a brownish-yellow hue. The legs are long, slender, and of a pale-yellow colour, the extremity of each joint being tinged with brown; the first pair is the longest, then the second, and the third pair is the shortest; each tarsus is terminated by three claws; the two superior ones are curved and slightly pectinated, and the inferior one is inflected near its base. The palpi are short, rather paler than the

legs, and the digital joint, which is tinged with brown, has a slender, slightly curved claw at its extremity. The abdomen is somewhat oviform, the posterior part, which is rather the broadest, sloping abruptly downwards at its extremity; it is moderately convex above, projects over the base of the cephalothorax, and is of a yellowish-white colour, faintly reticulated with brown; a dark-brown spot, which comprises a small yellowish-white one, occurs near the middle of the upper part, and is succeeded by two curved lines, which meet in an angle whose vertex is directed backwards; the abruptly sloped posterior extremity is of a brownish-black colour, with a series of minute yellowish-white spots on each side of the medial line; a brownish-black spot occurs on the anterior part of each side, and is followed by oblique curved lines, of a browner hue, whose lower extremities are enlarged and more or less confluent; a broad, deeply indented, brownish-black band, bordered with white, extends along the middle of the under part, and the branchial opercula and spinners have a dark-brown hue.

An immature female of this *Linyphia* was the only specimen of the species contained in the collection.

Family Epeïridæ.

Genus Epeïra, Walck.

Epeïra solers.

Epeïra solers, Walck. Hist. Nat. des Insect. Apt. tom. ii. p. 41; Blackw. Spiders of Great Britain and Ireland, part ii. p. 336, pl. 24. fig. 243.
—— *agalena*, Hahn, Die Arachn. Band ii. p. 29, tab. 47. fig. 115.
Atea sclopetaria, Koch, Uebers. des Arachn. Syst. erstes Heft, p. 4; Koch, Die Arachn. Band xi. p. 134, tab. 390. figs. 934, 935.

All the specimens of *Epeïra solers* contained in the collection were females, and were larger and darker-coloured than those which are indigenous to Britain.

Epeïra decens, n. sp.

Length of an immature male $\frac{3}{16}$ of an inch; length of the cephalothorax $\frac{1}{12}$, breadth $\frac{1}{16}$; breadth of the abdomen $\frac{1}{12}$; length of an anterior leg $\frac{7}{24}$; length of a leg of the third pair $\frac{1}{6}$.

The abdomen is oviform, moderately convex above, and projects over the base of the cephalothorax; a yellowish-white band, that tapers to its extremity, and is bisected longitudinally by an obscure yellowish-brown band, extends along the middle of the upper part, and comprises a fine, black, angular line, whose vertex is directed forwards, situated about a third of its length from the coccyx; on each side of this band there is a broad, parallel, brownish-olive band, whose exterior margin is sinuous,

each convex curve of the sinuosity including a black spot; the sides have a yellowish-white hue, their lower part being densely marked with pale-brown streaks and spots; the under part is of a dull-yellow colour, and comprises three longitudinal dark-brown bands, which meet at the spinners. The eyes are seated on black spots, and are disposed on the anterior part of the cephalothorax in two transverse rows; the four intermediate ones describe a trapezoid, the two anterior ones, which are placed on a protuberance, and are much wider apart than the posterior ones, being the largest of the eight; the eyes of each lateral pair are seated obliquely on a minute tubercle, and are near to each other, but not in contact. The cephalothorax is compressed before, rounded in front and on the sides, convex, glossy, with an indentation in the medial line of the posterior region; it is of a yellowish-brown colour, the cephalic region being much the palest, and has a narrow brown band extending along the middle. The falces are conical, vertical, armed with teeth on the inner surface, and have a pale brownish-yellow hue. The maxillæ are straight, and rounded at the extremity; and the lip is semicircular, but slightly pointed at the apex. These organs are of a brown colour at the base, that of their extremities being pale yellow. The sternum is heart-shaped, with eminences on the sides, opposite to the legs, and has a dark-brown hue tinged with red. The legs are moderately long, sparingly provided with hairs, and of a dull brownish-yellow colour; the first pair is the longest, then the second, and the third pair is the shortest; the tarsi are terminated by claws of the usual number and structure. The palpi are short, and paler than the legs. The very tumid digital joint of this specimen indicates that it had to undergo its final ecdysis before it arrived at maturity.

The immature male described above was the only individual of this species comprised in the collection.

Epeïra dorsuosa, n. sp.

Length of the female $\frac{1}{2}$ an inch; length of the cephalothorax $\frac{1}{5}$, breadth $\frac{1}{6}$; breadth of the abdomen $\frac{1}{4}$; length of an anterior leg $\frac{7}{10}$; length of a leg of the third pair $\frac{2}{5}$.

The eyes are disposed on the anterior part of the cephalothorax in two transverse rows; the four intermediate ones, which are the largest, are seated on a prominence, and nearly form a square; and the eyes of each lateral pair are placed obliquely on a tubercle, and are separated by a moderately wide interval. The cephalothorax is compressed before, rounded in front and on the sides, convex, clothed with hoary hairs, and has an indentation in the medial line of the posterior region; it is of a yellowish-brown colour, with a longitudinal dark-brown band in the middle, which is broadest in the cephalic region, and anothe

of the same hue parallel to each lateral margin. The falces are powerful, conical, vertical, armed with teeth on the inner surface, and are of a yellow-brown colour tinged with red at the extremity. The maxillæ are short, straight, and broadly rounded at the extremity; and the lip is semicircular, but somewhat pointed at the apex. These parts are of a dark-brown colour, that of their extremities being yellowish-white. The sternum is heart-shaped, pointed at the extremity, and has prominences on the sides, opposite to the legs; it is clothed with hoary hairs, and has a yellowish-brown hue, the medial line being the palest. The legs are robust, provided with hairs and spines, and are of a brown colour, with annuli of a darker hue; the first pair is the longest, then the second, and the third pair is the shortest; the tarsi are terminated by claws of the usual number and structure. The palpi resemble the legs in colour, and have a curved, pectinated claw at their extremity. The figure of the abdomen is somewhat quadrilateral, but the sides are rounded, and the anterior is broader than the posterior extremity; it is clothed with short hairs, projects over the base of the cephalothorax, and has two prominent tubercles on each side, and two large, parallel, obtuse ones situated above the spinners; the upper part, on which there are numerous circular glossy convexities, of various dimensions, in bas-relief, is of a yellowish-brown colour, an obscure, strongly dentated, yellowish-white line passing from each anterior tubercle to the two obtuse posterior tubercles; the lower part of each side is strongly tinged with dull yellow, and the under part has a dark-brown hue mingled with dull yellow, and a curved yellow band on each side: the sexual organs are well developed, and of a dark-brown hue tinged with red; their anterior margin is semicircular, and below it there are two glossy protuberances placed transversely; the branchial opercula are of a pale brown colour, and on each side of the spinners there are three dark-brown triangular spots, which are united at their bases.

Three females of *Epeïra dorsuosa*, two of which were adult and the other immature, were comprised in the collection. This species differs from the *Epeïra opuntiæ* of Dufour (see Walckenaer's 'Hist. Nat. des Insect. Apt.' tom. ii. p. 140), to which it is closely allied, in various particulars, and may readily be distinguished from it by the glossy convexities on the upper part of its abdomen.

Genus Gasteracantha, Latr.

Gasteracantha frontata.

Gasteracantha frontata, Blackw. Ann. & Mag. Nat. Hist. ser. 3. vol. xiv. p. 40.

The collection contained two females of this species, specimens

of which, of a somewhat smaller size, have been received from India.

The numerous instances of the distribution of spiders of the same species over extensive and widely distant regions of the globe may be explained by their having been conveyed across intervening oceans in ships and by the action of currents of air, especially of those known as the trade-winds and monsoons, on the silken filaments emitted from their spinners.

Genus Argyopes, Savigny.

Argyopes gracilis, n. sp.?

Length of an immature female $\frac{3}{5}$ of an inch; length of the cephalothorax $\frac{1}{6}$, breadth $\frac{1}{8}$; breadth of the abdomen $\frac{1}{5}$; length of an anterior leg $\frac{4}{5}$; length of a leg of the third pair $\frac{5}{8}$.

The abdomen is of an elongated slender figure; its anterior extremity, which has the appearance of having been cut directly across, has a minute tubercle on each side, and projects over the base of the cephalothorax; the posterior extremity, which almost tapers to a point, extends greatly beyond the spinners, and has a small protuberance on each side; the upper part is of a yellowish-white colour, with a dark-brown crescent-shaped mark at its anterior extremity, whose convexity is directed upwards, and spots and irregular streaks of the same hue on each side of the medial line, the latter being most conspicuous on its posterior half; three strong, conical, yellowish-white prominences, marked in front with a curved, oblique, dark-brown line that passes over their summit, project from each side, and below them there are numerous irregular longitudinal lines of the same hue; from each minute anterior tubercle a dark-brown line passes below the first lateral prominence; the under part, which is irregularly bordered with white, is of a brownish-black colour, and comprises some small white spots, three of which are disposed in a triangle near the spinners; these latter organs, with the branchial opercula, have a red-brown hue, and the inferior surface of the elongated tail-like extremity is densely freckled with black spots. The eyes are disposed on the anterior part of the cephalothorax in two transverse rows; the four intermediate ones are placed on a protuberance, and nearly form a square; and the eyes of each lateral pair are seated obliquely on a tubercle, and are near to each other, but not in contact, the anterior one being much the smallest of the eight. The cephalothorax is compressed before, rounded in front and on the sides, slightly convex, with a shallow, brown indentation in the medial line of the posterior region; it is of a pale dull-yellow hue, with a broad brown band extending from each side of the cephalic region to the base,

where the two are united by a transverse bar of the same hue; two pale brown spots occur behind the posterior pair of eyes, and the whole is clothed with white hairs having a silvery lustre. The falces are powerful, conical, vertical, armed with teeth on the inner surface, and of a pale dull-yellow colour, with an obscure brown line extending along their inner side, and passing obliquely above their extremity. The maxillæ are short, strong, and greatly enlarged and rounded at the extremity; the lip is semicircular, but somewhat pointed at the apex; and the sternum, which is heart-shaped and hairy, has eminences on the sides, opposite to the legs. These parts are of a dark-brown colour; the extremity of the maxillæ and the apex of the lip have a brownish-yellow hue; and a band extending along the middle of the sternum, from each side of which a streak is directed obliquely backwards and outwards, is of a pale dull-yellow colour. The legs are long, slender, provided with hairs and a few spines, and are of a dark-brown hue, with broad brownish-yellow annuli; the first pair is the longest, then the second, and the third pair is the shortest; the tarsi are terminated by claws of the usual number and structure. The palpi are long, of a pale dull-yellow colour, and have a curved, pectinated claw at their extremity.

Although this spider differs remarkably in form and in some other particulars from *Argyopes caudatus* (see the 'Annals and Mag. of Nat. Hist.' ser. 3. vol. xvi. p. 346), yet it possibly may be an immature individual of that species, to which it bears some striking points of resemblance.

Genus Eurysoma, Koch.

Eurysoma vicina, n. sp.

Length of the female $1\frac{1}{10}$ inch; length of the cephalothorax $\frac{1}{2}$, breadth $\frac{9}{20}$; breadth of the abdomen $\frac{9}{10}$; length of a posterior leg $1\frac{5}{12}$; length of a leg of the third pair $\frac{19}{20}$.

The eyes are disposed on the anterior part of the cephalothorax in two transverse rows; the four intermediate ones are seated on a protuberance, and form a trapezoid, the two anterior ones, which are nearer to each other than the posterior ones, being the largest of the eight; the eyes of each lateral pair are placed apart on a strong tubercle, and are distant from the four intermediate ones. The cephalothorax is large, compressed before, truncated in front, and rounded on the sides, which are marked with furrows converging towards the middle; the cephalic region, which is greatly elevated above the posterior part, has four conical glossy tubercles disposed in a transverse

row behind the eyes, and is densely clothed with hoary hairs; the falces are short, very powerful, subconical, vertical, and armed with teeth on the inner surface; the maxillæ are short, strong, straight, and greatly enlarged and rounded at the extremity; the lip is semicircular; and the sternum is heart-shaped, with small eminences on the sides, opposite to the legs. These parts are of a brownish-black colour, the base and lateral margins of the cephalothorax being tinged with red. The legs are moderately long and robust, the genua, tibiæ, and metatarsi being somewhat depressed; they have a very dark brown hue, are provided with hoary hairs on the upper surface, and have a patch of white hairs at the base of the tibiæ, and at the base and extremity of the metatarsi on the under side; the fourth pair, which is the longest, very slightly surpasses the first pair, and the third pair is the shortest; the tarsi are terminated by claws of the usual number and structure. The palpi are rather short, somewhat depressed, of a very dark brown hue, provided with hoary hairs intermixed with some of a brownish-red colour on the upper surface, and have a curved, pectinated claw at their extremity. The abdomen is circular, without spines, truncated in front, moderately convex above, and projects greatly over the base of the cephalothorax; the upper part is of a brownish-yellow colour; three conspicuous, depressed, brown spots form a row on each side of the medial line, and numerous smaller depressed spots of the same hue occur in front and on the sides; four conical tubercles form a curved row on each side of the anterior part, the anterior one being much the smallest; three other tubercles form a transverse row between the posterior ones of the two curved rows; two others are placed wide apart on the posterior half, and four more, nearly describing a square, are situated above the spinners; the sides and front are paler than the upper part, and are densely clothed with hoary hairs; the under part has a brown hue, the sexual organs and spinners being the darkest, and the branchial opercula the palest, and there is a transverse pale-buff band immediately behind the sexual organs, which are well developed, with a convex protuberance on each side, and between them a fine, pointed process connected with their anterior margin.

The collection contained a single adult female of this fine *Eurysoma*, which is very closely allied to the *Epeïra imperialis* of Walckenaer, 'Hist. Nat. des Insect. Apt.' tom. ii. p. 147 (*Eurysoma sexcuspidata*, Koch, Uebers. des Arachn. Syst., fünftes Heft, p. 10), but differs from it in various particulars, and especially in the number and disposition of the tubercles on the abdomen.

Genus Nephila, Leach.

Nephila geniculata.

Epeïra geniculata, Walck. Hist. Nat. des Insect. Apt. tom. ii. p. 96.

Adult and immature females of this handsome *Nephila* were included in the collection.

Genus Tetragnatha, Latr.

Tetragnatha festiva, n. sp.

Length of the female $\frac{5}{12}$ of an inch; length of the cephalothorax $\frac{1}{6}$, breadth $\frac{1}{10}$; breadth of the abdomen $\frac{1}{8}$.

The cephalothorax is compressed before, rounded in front and on the sides, slightly convex, glossy, with a large indentation in the medial line of the posterior region; it is of a yellowish-brown colour, with a red-brown band parallel to each lateral margin, and another in the medial line, whose greatly enlarged anterior extremity comprises the whole of the cephalic region. The falces are powerful, conical, vertical, very convex in front, glossy, armed with teeth on the inner surface, and have a red hue tinged with brown. The maxillæ are straight, enlarged at the extremity, which is somewhat angular on the outer side, and of a brownish-red colour. The lip is semicircular and prominent at the apex; and the sternum is heart-shaped, with prominences on the sides, opposite to the legs. These parts are of a dark-brown colour tinged with red, the apex of the former and the lateral margins of the latter having a yellowish-red hue. The legs are long, slender, provided with hairs, and of a brown colour, the base of the femora being the palest; their relative length could not be ascertained, as they were detached and mutilated; but, judging from the relative size of the coxæ, the first pair should be the longest, then the second, and the third pair the shortest. The palpi are long, slender, of a brownish-yellow hue, and have a slightly curved, minutely pectinated claw at their extremity. The eyes are seated on black spots on the anterior part of the cephalothorax; the four intermediate ones nearly form a square; the two anterior ones, which are placed on a slight protuberance, are rather nearer to each other than the posterior ones, which are the largest of the eight; the eyes of each lateral pair are seated near to each other on a small tubercle, the posterior one being the smallest. The abdomen is subcylindrical, tapering somewhat to the extremity, which is obtuse, slightly curved upwards, and extends beyond the spinners; and there is an obtuse protuberance on each side of the anterior extremity, which projects over the base of the cephalothorax; the upper part and sides have a silvery lustre, with a slight golden tinge, and on

each side of the medial line there is a red band having a bright golden lustre; in the space between these bands another band extends, that projects from each side three short streaks directed obliquely backwards, and has a small spot on each side, near its posterior extremity; the band, streaks, and spots, with the two anterior protuberances, have a black hue; the under part has a silvery lustre, with a slight golden tinge, and is bounded on each side by two longitudinal dark-brown bands, comprising between them another of a dull-red hue: the sexual organs form a transverse oval; a small process is connected with their posterior margin, and their colour is pale reddish-brown; the branchial opercula have a yellow hue, and that of the spinners is brown.

The collection contained an adult female of this brilliant *Tetragnatha*.

Tribe Senoculina.

Family Scytodidæ.

Genus Scytodes, Latr.

Scytodes thoracica.

Scytodes thoracica, Walck. Hist. Nat. des Insect. Apt. tom. i. p. 270; Latr. Gen. Crust. et Insect. tom. i. p. 99; Blackw. Spiders of Great Britain and Ireland, part 2. p. 380, pl. 29. fig. 272.
—— *tigrina*, Koch, Die Arachn. Band v. p. 87, tab. 167. fig. 398.

One adult female of this species was included in the collection.

LVIII.—*Additional Note on the* Antilocapridæ. By Dr. J. E. Gray, F.R.S. &c.

After my notes on this family were written and the manuscript sent to the printer, I heard that Dr. Sclater had made some observations on the genus at the British-Association Meeting at Nottingham. The paper is published in the last Number of the Annals. I am very glad to find that Dr. Sclater agrees with me in the necessity of forming the genus into a peculiar family.

Dr. Sclater has adopted Dr. Sundevall's division of the Ruminants into two groups, according to the form of the foot; but I think his change of Sundevall's term *Digitigrada* into *Phalangigrada* is to be regretted, as adding a useless synonym.

There is no doubt that the form of the *placenta* is an interesting physiological fact; but I doubt its applicability to zoological classification. It is only to be observed at one period of the animal's life, and is only known in a very few species: for example, I am not aware that it is known in *Antilocapra*, the

genus under consideration; and if it differs in two genera so nearly allied as *Tragulus* and *Moschus*, which many modern zoologists consider only species of one genus, what right have we to assume that it is similar in all the genera of *Bovidæ* and *Cervidæ*, more especially as the placenta of very few species of the large group of Antelopes and Deer is known.

Dr. Sclater proposes to divide the *Ruminantia unguligrada* with placenta polycotyledonaria into *pedes didactyli* and *pedes tetradactyli*; but this character will not separate *Antilocapridæ* from *Bovidæ*, unless he proposes to arrange several animals which have been called Antelopes, and which have simple horns with a permanent horny sheath, and which therefore do not agree with his other characters of the group, in the family *Antilocapridæ*; for the genera *Nesotragus* and *Nanotragus*, and one species of the genus *Calotragus* are as destitute of false hoofs as the genus *Antilocapra*. Dr. Sundevall considers the absence of this false hoof of so little importance that he places two species in the genus *Calotragus*, one having large and the other being entirely without false hoofs. Dr. Sclater must have overlooked this fact when he says, "two other points in which the Prong-horn differs from all the other *Bovidæ*," and proceeds, "in the absence of the 'false hoofs,' as the stunted terminations of the rudimental second and fifth digits of each foot are termed."

LIX.—*On the Vision of Fishes and Amphibia.* By Félix Plateau*.

The eyes of animals have formed the subject of a great number of investigations, which, however, have been almost always directed to a purely anatomical end. In studying the physiology of vision, observers have, so to speak, confined themselves to man, and the question of the vision of animals, interesting as it is, has only been lightly touched upon; moreover physiologists have generally proceeded by analogy, very rarely supported by experiment. There are especially two groups of living creatures which, differing so much in their habits from man, merited investigation from the point of view of their vision, namely the Fishes and Amphibia; and it is these which I determined specially to examine.

In order to show to what kind of investigations and experiments I have subjected the eye of these animals, let us conceive for a moment an ideal typical eye of a fish. Its cornea will be perfectly flat, its crystalline spherical, and the aqueous and

* From the Mém. Cour. et Mém. des Savants Etrang. de l'Acad. Roy. de Bruxelles, tome xxxiii. Communicated by the Author.

vitreous humours of the same density as water and in small quantity. Let us place this eye successively in water and in the air, and examine what will be the course of the rays traversing the organ in these two different media. In water, whatever be the form of the cornea, as the aqueous and vitreous humours have, by hypothesis, the same density as this fluid, the cornea will play the part of a transparent lamina with parallel faces bathed with water on both sides; it will therefore by no means serve to render the luminous rays convergent or less divergent, and the crystalline alone will remain to combine in one point upon the retina the rays of each bundle. It must therefore be very convex and of relatively considerable density.

Will this eye, organized for distinct vision in water, be unfitted for distinct vision in the air? By no means. Let us suppose, in the first place, a bundle of parallel rays falling upon the anterior surface of the eye; these rays will arrive at the crystalline retaining their parallelism, as the two surfaces of the cornea are flat and parallel, and it will be seen that, both in air and water, it is solely to the crystalline that is deputed the function of picturing the image at the bottom of the globe of the eye.

Let us suppose, further, that the axis of the eye is of the proper length for the vision of objects sufficiently distant to allow the rays composing each bundle to be regarded as parallel. A fish furnished with a visual apparatus constructed on the above plan would see as distinctly in air as in water objects situated at a great distance, of course assuming the water to be of perfect transparency.

Let us now examine the case of near objects. Although Fishes in general have very large eyes, the orifice of the pupil never presents a very great diameter; hence, supposing the object looked at to be near the eye (a few centimetres from it for example), the cones of rays emanating from each point of this object would still present a very small base in comparison to their length, and the rays constituting them will form but very small angles with the axes of these same cones. From this it follows that, even if we ascribe to the axis of our typical eye a length corresponding with the distinct vision of objects at a few centimetres' distance, this vision will still be as distinct in air as in water, except that the distance of the object must be rather less in the air. There, in fact, the slight divergence of the rays emanating from one point of the object will be necessarily somewhat diminished as they penetrate into the aqueous humour, and consequently, after their refraction by the crystalline, they will converge at a point somewhat nearer the cornea than if the object were in water. It will therefore be necessary to diminish slightly the distance of the object in order to give the rays a greater di-

vergence and thus compensate the slight refraction produced at their entrance into the eye.

As I shall show hereafter, the actual eye of Fishes closely approaches our ideal type, so that we are entitled to conclude theoretically that these animals can see distinctly in the air, and that their distance of distinct vision must be nearly the same in this medium and in water. Although Fishes, with the exception of some privileged species, such as the Eel, the *Chironectes*, and the climbing Perch, have hardly any need for combining the faculty of seeing distinctly in water with that of seeing distinctly in the air, this double faculty is evidently indispensable to the Amphibia.

It will be easily understood that if we suppose the eye of these latter animals to be constructed exactly like that of animals living exclusively in the air, their vision in water will be confused. In fact, as I have already said, when once the eye is immersed in water neither the cornea nor the aqueous humour has any action, and the crystalline remains alone; but, as in the supposition which we have just made its curvature would be slight, it would no longer suffice to cause the rays to converge upon the retina, or, in other words, its focus would be far behind this. This, as is well known, is what happens in the eye of a man, for example, when diving in the water.

Have the Amphibia so great a power of adaptation as to render their crystalline spherical? This appears, *à priori*, to be doubtful.

It is, on the other hand, very easy to assume that the eye of the Amphibia is organized exactly, or very nearly, like that of creatures living exclusively in water, since in that case the distance at which the animal sees distinctly without effort of the eye must be pretty nearly the same in water and in air.

The purpose of my investigations is to show that the eye of Fishes closely approaches our ideal type, and that that of the Amphibia is almost exactly like it, and, finally, to prove experimentally that distinct vision takes place at sensibly equal distances in air and in water, and with the same perfection in both media, in all the animals under consideration.

I therefore, in the first place, examine what is the exact form of the cornea in Fishes. By simple examination, by the reflection upon this membrane of a dark rectilinear object standing out from a luminous ground, and the image of which, when the eye is looked at from the side, is incurved by the curvature, and, finally, by the actual measurement of the radius of this curve upon a model of the eye taken immediately after the death of the animal, I find that the cornea of Fishes, although rather variable as regards its projection upon the surface of the head,

is always flat, or at least much flattened in front of the crystalline and over a space equal to the diameter of that lens, whilst the lateral portions may be much curved. As to the crystalline, I have always found it very nearly a sphere, as, indeed, is well known. Lastly, Cuvier and Monro long since proved that in Fishes the humours of the eye may be assimilated to water. In other words, I prove, by a sufficient number of measurements detailed in one of the tables of my memoir, that the eye of Fishes is always constructed evidently on the plan of the ideal type which I have described above, even in those species which some authors have indicated as exceptional.

I subject the eyes of the Amphibia (that is to say, of the animals which must make use of their organs of vision indifferently in water and in air) to the same investigations, and I show that in all, Mammalia, Birds, Reptiles, Batrachia, &c., the eyes, with the exception of some slight differences, exhibit a structure identical with that of these organs in Fishes. As regards Insects, whether terrestrial, aquatic, or amphibious, they all, according to modern researches, possess eyes with flattened corneæ and the crystallines very convex, at least on the inner surface. Here the anatomical portion of my investigation terminates; and then follows the experimental part, in which I determined the distances of distinct vision of ten species of Fishes of different genera, and of some Batrachia, in air and in water.

The method which I have employed is, in few words, as follows, supposing we have to do with a fish, and the process is the same with other animals. After rapidly killing the individual to be experimented on, one eye is carefully removed from its orbit without alteration of its shape, and then fixed by means of pins and of the fragments of the conjunctiva and muscles upon a plate of cork, in such a manner that the cornea shall be vertical. A suitable aperture is then made at the bottom of the eye, by removing with fine scissors a portion of the sclerotic and retina, and in this aperture is fixed a small glass cup slightly roughened, upon which the image of an external object may be depicted as upon an artificial retina. The object employed is the extremity of a fine iron wire thrown out by the flame of a lamp. The experiment must of course be made at night, or in a room with closed shutters, and the image of the iron wire on the hinder part of the eye is observed by means of a lens. By varying the distance from the iron wire to the cornea, we may always at last attain a position in which the image is distinct. The experiment is repeated a certain number of times to give a mean, and is performed successively in air and water; in the latter case, of course, the iron wire is also immersed in the water. I need hardly add

that this liquid is contained in a little box, of which the anterior and posterior surfaces are made of thin glass.

The numbers which I have obtained in the same medium and for the same individual are very close, which justifies our having confidence in the results of experiments so delicate; but, moreover, as may be seen from the table which I give in my memoir, the distances of distinct vision in the air and in water are always very nearly the same. Fishes, therefore, as I have already said from the consideration of the structure of the eye, see as well in the air as in water.

Hence, also, the vision of Amphibia finds a natural explanation, as the visual organs of those animals resemble those of Fishes. Nevertheless, as a confirmation of the theory, I have subjected to the same experiments the eyes of some Batrachia; and in these also the distances of distinct vision in air and in water are, so to speak, identical. I shall only remark, in concluding this analysis, that, in the Amphibia, distinct vision, which is necessarily very short in water in consequence of the imperfect transparency of that medium, must, on the contrary, be able to extend itself in the air to very variable distances, which necessitates the existence of a faculty of accommodation; and accordingly the presence of the ciliary muscle, the chief agent of that faculty, has been recognized in their eyes.

LX.—*Description of a new Siluroid Fish from Ceylon.* By Dr. Albert Günther.

[Plate XV.]

A small collection of freshwater fishes, made by the Rev. Bancroft Boake in Ceylon, and kindly submitted to my examination by F. Layard, Esq., contained two Siluroid fishes of the genus *Arius*, which are of great interest, inasmuch as they prove that the peculiar habit which I have described in an American species, *A. fissus* (Fish. v. p. 173), viz. the mode in which the parent fish takes care of its progeny, is not confined to South-American species, but exists also in the East-Indian ones. The mature ova are of the same large size in all these fish; and in all it is the male which carries them in the spacious cavity of its mouth. According to Mr. Boake, who has published an account of the habits of these fish, they are called *Angaluwa*. Three specimens were in the collection, belonging, however, to two very distinct species, new to science. Two of these, a male and a female, 14 inches long, are *Arius Boakii*, so named by Mr. W. Turner, who also had received examples, and read an account of them at the last meeting of the British Association. We may there-

fore be satisfied with mentioning here that this species is, curiously enough, so closely allied to the *A. fissus,* that, but for the remoteness of their respective habitats, we should almost have hesitated to separate them specifically. The female may be externally distinguished by a broad oblique fold of the skin on the inner side of the ventral fins. The second species is

Arius Layardi, sp. n. Plate XV.

This species is closely allied to *A. tonggol* and *A. argyropleuron,* from the East-Indian archipelago, but differs in having no trace of vomerine teeth, and in possessing longer maxillary barbels.

D. 1/7. A. 18. P. 1/11.

The height of the body is contained four times and four-fifths in the total length (without caudal), the length of the head three times and one-third; head depressed, broader than high, its width being three-fifths of its entire length, or equal to its length without snout. Head above nearly entirely covered by skin, only the ridge of the occipital process being granular. Occipital process triangular, with the lateral margins straight, longer than broad; it is raised into a median ridge along the middle, which, on the head, is continued as a narrow, deep, uninterrupted groove, terminating on the snout. Basal bone of the dorsal spine narrow. Vomerine teeth none; teeth on the palate coarsely granular, in two pear-shaped groups, situated as far back as in *A. tonggol* (see Günth. Fish. v. p. 164), and much convergent behind. Snout much depressed, produced; the upper jaw somewhat prominent, but rather shorter than the postorbital portion of the head. The maxillary barbels extend to the root of the pectoral. The soft dorsal fin is as high as the body; its spine is rather slender, as long as the head without snout; granulated in front and serrated behind. Pectoral spine as strong as, and rather shorter than, that of the dorsal fin. Caudal deeply forked, with the lobes subequal in length. Colour immaculate.

A male, 11 inches long, is in the collection.

We may add the Ceylonese names of several species sent by Mr. Boake:—Rallia = *Etroplus maculatus*; Corallia = *Etroplus suratensis*; Loola = *Ophiocephalus striatus*; Connia = *Ophiocephalus Kelaartii*; Hoonga = *Clarias Teysmanni*; Kamaya = *Anabas oligolepis*; Pooloota = *Polyacanthus signatus*; Kanaya = *Channa orientalis.*

The Cyprinoids will be described in the seventh volume of the 'Catalogue of Fishes.'

LXI.—*On an Upper Incisor of* Nototherium Mitchellii. By Professor R. Owen, F.R.S.

[Plate XVI.]

To the Editors of the Annals and Magazine of Natural History.

Gentlemen,

I have received, through the kindness of Sir Daniel Cooper, Bart., from the freshwater beds of Gowrie Creek, Darling Downs, Queensland, an upper front incisor, right side, of the *Nototherium Mitchellii* (Pl. XVI.), which so closely accords in size with the dimensions of the tooth described and figured in the December Number of your volume xvi. (1865) p. 448, by Prof. M'Coy, that I am disposed to ascribe that tooth also to the species near the remains of which it was found, "at Murchill, not far from Geelong, Victoria."

My specimen is 5 inches 1 line long in a straight line, 1 inch 7½ lines in the greatest (fore-and-aft) diameter, which is about the middle of the root; 10 lines in greatest transverse diameter. The enamelled crown, *e*, is 1 inch in length, bevelled off, chiselwise, from before downward and backward, and shows the partial application of enamel usual in such teeth; the free margin on the outer side of the crown (fig. 4) extends further back than that on the inner side (fig. 1 *e*), and is slightly everted: it is also thicker than the even inner border. The breadth of the unenamelled back part of the crown (figs. 1, 3, 4 *d*) at its base is 6½ lines: owing to the difference in extent of enamel on the sides of the crown, the abraded surface slopes from without inward and backward, as well as from above downward and backward. The enamel is ¼ of a line in thickness at the outer side of the crown: the whole outer surface is smooth. The crown is broadly convex anteriorly, rather flatter on the inner than on the outer side. The root is more thickly covered by cement, and increases in every dimension, chiefly from before backwards, as it recedes from the crown, until at a little below its midlength it attains the dimensions above given: it then diminishes to the pulp end. The outer side begins to be impressed by a longitudinal shallow channel about an inch and a half below the crown; and this channel increases in breadth, but not in depth, becoming, indeed, shallower near the pulp end of the root. On the inner side, the longitudinal channel begins somewhat nearer the crown, and sinks deeper as it recedes, besides becoming wider. The tooth is "compressed and gently incurved," or, rather, "recurved," the front margin describing a greater convexity, lengthwise, than the hind margin: the root

contracts to an antero-posterior diameter of 1 inch 3 lines, and a transverse diameter of $4\frac{1}{2}$ lines, at the end of which it is excavated by the shallow remnant of the pulp-cavity (fig. 6). The breadth here, owing to the opposite lateral channels, is least at the middle of this end, where it contracts to 3 lines; the part anterior to this gives the breadth of $4\frac{1}{2}$ lines. Thus the present tooth is less "fusiform" than Prof. M'Coy's specimen, which may be due to its having come from a less-aged individual. The Professor's description of the "crown, worn down obliquely almost to the base, only about an inch of it remaining," applies, however, equally to my specimen. The cement-covered outer surface of the root is marked by the same "short, irregular, interrupted longitudinal grooves," with intervening ridges about a line in breadth.

The difference between the Professor's specimen and the homologous tooth of *Thylacoleo carnifex* is, first, in dimensions. The figure given at p. 448, *loc. cit.*, is reduced to nearly half the natural size of the tooth there described, and of the Professor's original "pen-and-ink sketch;" and a notice of such reduction in the woodcut has been omitted. As it stands, it nearly represents the natural size of the upper front incisor of *Thylacoleo carnifex*, the root of which is about 2 inches in length, and 10 lines in greatest breadth. But the crown is relatively longer, the enamel is twice as thick, and its free end is not bevelled off chiselwise, as in Professor M'Coy's specimen and in mine of *Nototherium Mitchellii.*

Reduction of figures of single or detached teeth should, if possible, be avoided: it detracts much from the facility of comparison. The figures of the tooth here described are of the natural size.

I may add that the tooth supposed to be a canine of *Thylacoleo* is shown to be an incisor, in my second memoir on that genus in the Philosophical Transactions for 1866.

I am, Gentlemen,

Yours faithfully,

RICHARD OWEN.

British Museum.

EXPLANATION OF PLATE XVI.

Fig. 1. Side view of anterior incisor, right side, upper jaw, of *Nototherium Mitchellii.*
Fig. 2. Back view.
Fig. 3. End view of crown.
Fig. 4. Outer-side view of crown.
Fig. 5. Section of middle of root.
Fig. 6. Free extremity of root.

LXII.—*Notes on* Sphærion *and* Mallocera.

By Francis P. Pascoe, F.L.S., F.Z.S., late Pres. Ent. Soc., &c.

Many of the tropical American genera of the Longicorn family Cerambycidæ are crowded with discrepant species, most of which, although undescribed, have manuscript or catalogue names in collections. As a rule, these species seem to have been referred to such of the comparatively few published genera to which they appear most approximate, without regard to their technical characters. I have been recently examining *Sphærion* and *Mallocera,* two allied genera belonging to the same subfamily as the typical *Cerambyx,* and I find under each of those names forms that could never be held together by any definitive formulæ. The following notes are only the results of the working out of my own limited number of examples, aided, however, by the examination of those in the British Museum, including M. Chevrolat's, in which so many of the celebrated Baron Dejean's "catalogue-types" are found.

Mr. Newman's genus *Nephalius**, which has been regarded almost invariably as purely synonymous with *Sphærion,* ought, I think, to be preserved for those of his species which have the elytra imperfectly embracing the abdomen, or, in other words, elytra without or with very slightly deflected sides. The type would then be *N. cassus,* and the genus would include *N. serius* and *N. exutus*; of his other species, *N. amictus* is unknown to me, and *N. blandus* is a true *Sphærion.* The remaining species of *Sphærion* which I have examined are:—*S. cyanipenne,* Serv. (the type), *S. armigerum,* Wh., *S. terminatum,* Perroud, *S. suturale* (Dej.), *S. plicicolle,* Germ., *S. geniculatum,* n.sp., *S. pubescens,* Ol., *S. Erichsonii,* Wh., *S. subpiceum,* Wh., and *S. Poëyi,* Chev. *S. orientale,* Wh., *S. inerme,* Wh., *S. triste,* Guér., and *S. insulare,* Wh., may be regarded as degraded members of the genus. Two species (*S. melanura* and *S. procerum*), described by Erichson in Schomburgk's 'Reisen in Britisch-Guiana,' are unknown to me; so also is *S. rusticum,* lately published by Prof. Burmeister in the 'Stettiner Entom. Zeitung' (1865, p. 167). Of the undescribed Sphærions I have selected those only for description for which new genera will be necessary, and have characterized two species hitherto only known by their catalogue-names.

* Entom. p. 93. The genus, however, can scarcely be said to be characterized by Mr. Newman. M. Thomson afterwards described "*Nephalius*" in his 'Essai' (p. 245), but in his later work, 'Systema Cerambycidarum,' he revokes the name with the note "*nec* Newman," and proposes '*Peribœum*' for the generic name of the species previously published by him as *Nephalius acuminatus.*

In the genus *Mallocera*, which Serville places between *Eurymerus* and *Purpuricenus*, we may include *M. opulenta*, Newm., although the apices of the elytra are not in accordance with Serville's description; but the three Peruvian species described by Erichson (Wiegmann's Arch. 1847, pp. 140–141) must remain doubtful for the present. *M. undulans* and *lateralis* of White have been separated by M. Thomson to form his genus *Appula*: but this seems to me to be synonymous with *Stizocera*, Serv.; indeed *M. lateralis* stands under the name of "*Stizocera armata*, Serv." in some collections, but the species scarcely agrees with that author's description. *Appula*, or rather *Stizocera*, only differs from *Mallocera* in the four posterior femora terminating in spines—a character of possibly only specific importance. *Mallocera eburioides*, Wh., is better placed among the allies of *Eburia*, as the fourth joint of the antennæ is as long as the succeeding one, which is not the case in the *Sphærion* set; and it has the habit of *Eburia*, including the raised ivory-like spots of that genus. A species well known as *Mallocera obliqua* (Dej.), but described by Serville as a *Trichophorus*, is now the genus *Eurysthea*, Thomson. Another well-known species, *Mallocera virgata* (Chev. MS.) I have here separated under the generic name of *Limozota*. *M. simplex*, Wh., can only be regarded as a very aberrant member, if one at all, of the genus in which Mr. White has placed it.

Before describing the new genera, the following short diagnostic formula will serve to distinguish *Sphærion* as it is here limited:—

Sphærion.

Antennæ elongatæ (in fœm. corpore æquales); art. 3$^{\text{tio}}$–6$^{\text{um}}$ vel 7$^{\text{um}}$ spinosis.
Prothorax subdepressus.
Tibiæ posticæ subcompressæ vel vix subcompressæ, calcaratæ.

It should be observed that the prothorax, except in being cylindrical, as opposed to depressed, affords no characters of generic value, for it is found to vary considerably in closely allied species: the basal antennal joints are often longitudinally grooved; but this character also is not to be relied on. Nearly all the species referred to *Sphærion* and *Mallocera* are natives of the tropical parts of North and South America*.

The first of the two species here described is, I believe, *S. suturale* of Dejean's Catalogue.

* *S. orientale*, Wh., represented by a single specimen in the British Museum, is said to be from India.

Sphærion suturale.

S. læte rufo-castaneum, nitidum; elytris testaceis, sutura spinisque nigris; antennis, scapo excepto, tibiis tarsisque nigris.

Hab. Brazil.

Head, prothorax, femora, and body beneath bright glossy reddish chestnut; elytra testaceous, the suture and apical spines black; prothorax subcylindrical, the disk with four obtuse tubercles; elytra finely punctured, with three scarcely apparent pale lines on each; antennæ, except the scape, tibiæ, and tarsi, dull black. Length 10 lines.

Resembles in general coloration *S. terminatum*, Perroud, but with black antennæ, suture, tibiæ, &c., and the prothorax entirely different in form, and without the central tubercle; above all, with the posterior femora nearly linear, as in *Elaphidion*.

Sphærion geniculatum.

S. testaceum, nitidum; capite prothoraceque castaneis, hoc oblongo-ovato; disco transversim plicato; femoribus apice nigris.

Hab. Brazil.

Testaceous, shining; head and prothorax reddish chestnut, the latter oblong ovate, without spines or tubercles, finely plicate across the disk; elytra with small distant punctures, the suture near the apex and spines black; body beneath pale chestnut; femora with their apices glossy black; antennæ pale testaceous. Length 7 lines.

Sphærion plicicolle, Germ., its nearest ally, has a broad prothorax, scarcely shining, with much coarser sculpture, the punctures on the base of the elytra larger and crowded together, and the femora nearly unicolorous.

Mephritus.

Caput inter antennas projectum.
Prothorax subdepressus.
Tibiæ compressæ, posticæ apice haud spinosæ.

The compressed tibiæ, which are strengthened by a strong ridge on each side for their whole length, and the absence of a true spine to the hinder pair (replaced, however, by a broad angular process) cut off this genus from all its allies. The head is very short, and between the bases of the antennæ there is a prominent roll, formed apparently by the antennary tubers, which are otherwise obsolete; the antennæ are longer than the body, fimbriated beneath, the third, fourth, and fifth joints deeply grooved, and they are also spined at the apex; the prothorax is slightly transverse, obscurely tuberculate on the disk, the sides projecting into a short spine nearly in the middle; the

elytra are flattish, terminating in a median spine; the femora are rather fusiform than clavate, and the basal joint of the posterior tarsi is as long as the rest together. The type is a tolerably large insect, and is the *Sphærion cinerascens* of Dejean's Catalogue, but has never, I believe, been described.

Mephritus cinerascens.

M. brunneus, pube subtili cinerea omnino indutus.

Hab. Rio Janeiro.

Reddish brown, everywhere covered with a delicate ashy or ashy-grey pubescence; head and prothorax nearly free from punctures. Scutellum semicircular; elytra rather closely and finely punctured, towards the apex impunctate; antennæ, tibiæ, and tarsi blackish. Length 14 lines.

CASTIALE.

Antennæ elongatæ, art. 3$^{\text{tio}}$–6$^{\text{um}}$ apice spinosis; tuberibus antenniferis horizontalibus.
Prothorax breviter ovatus, subdepressus.
Femora tenuiter fusiformia, quatuor posteriorum apice bispinoso.

In this genus the femora are slender and fusiform, the four posterior bispinous at their apices; the head has a little more muzzle than usual, and the antennary tubers are projecting in front, and divided by a narrowly impressed line; the antennæ are much longer than the body, and the third to the fifth joints are grooved and spined, as in the preceding genus; the prothorax is oblong, with a slightly raised central line, and four obscure tubercles on the disk; the elytra terminate in an exterior spine; the tibiæ and tarsi are slender, the basal joint of the posterior tarsi not longer than the two following. The type is a beautiful insect bearing the name of "*Sphærion elegantulum*, Buq.," in the British Museum collection.

Castiale viridipennis.

C. rufescens; elytris læte viridibus; antennis pedibusque fuscis.

Hab. Columbia.

Brownish red, clothed with scattered pale-greyish hairs; head sparsely punctured; prothorax transversely corrugated, the disk with four flattish unicolorous tubercles, and a short central elevated line; scutellum semicircular; elytra rich green, shining, minutely shagreened, the scattered punctures each giving origin to a long slender hair; body beneath reddish; legs and antennæ blackish, with scattered slender hairs, the latter nearly twice as long as the body. Length 7 lines.

Gorybia.

Caput fere ad oculos insertum.
Antennæ corpore vix longiores, inermes.
Prothorax subdepressus.
Tarsi postici breves.

The retracted head and unarmed antennæ are the chief diagnostic characters of this genus; the former is very short, with the eyes prominent and adding considerably to its breadth; the antennæ are unarmed, but the third, fourth, and fifth joints have each above half a dozen longitudinal ridges; the prothorax is very much constricted posteriorly, and is without tubercles and spines; the elytra have the usual external spine at their apices; the femora are clavate; the posterior tarsi shorter than the intermediate; the first abdominal segment is twice as long as the second, instead of being only about the same length or a little longer. The specimen here described is probably a female.

Gorybia martes.

G. ferruginea; capite, prothorace, pedibusque fuscis, opacis; apicibus elytrorum nigricantibus, nitidis.

Hab. Espiritu Santo.

Ferruginous, with sparse greyish hairs; head and prothorax opaque, brown, the former obscurely, the latter very distinctly reticulately impressed; scutellum rounded; elytra rather coarsely punctured at the base, ferruginous towards the apex, impunctate, blackish, and glossy; propectus dull brown, rest of the under and clavate portions of the thighs glossy reddish brown; antennæ, tibiæ, and tarsi dull brownish. Length 4 lines.

Psyrassa.

Antennæ breviusculæ, vel corpore vix longiores, art. 3^{tio}–6^{um} apice spinosis.
Prothorax oblongus, subcylindricus, haud tuberculatus, basi angustior.
Elytra angusta, elongata, apicibus bispinosis.
Femora haud clavata.

This is a narrow form, more resembling *Ibidion* in habit than *Sphærion*; the antennæ in the typical species are much shorter than the body, distant at their base, with their tubers nearly obsolete; the eyes are prominent, and give the head a greater breadth than the prothorax; the latter is elongate, subcylindrical, and without tubercles or spines; the elytra are narrow and nearly parallel, the apex of each terminating in two spines; the femora are a little thickened in the middle, but not clavate;

the tarsi are rather short, with the basal joint of the posterior not longer than the two next together. The type is an insect collected in some abundance in Central America by M. Pilate, who gave it the MS. name of *Sphærion basicorne.* What the specific name is in allusion to, I am not aware; as, however, it is so known in collections, I have not altered it. *Stenocorus unicolor*, Randal, may be referred to this genus.

Psyrassa basicornis.

P. ferruginea, nitida, dimidio apicali elytrorum nigricante.

Hab. Yucatan.

Ferruginous, shining, with sparsely scattered hairs, rather coarsely punctured above, less so on the head; scutellum equilaterally triangular, covered with a close silvery pubescence; elytra with the posterior half blackish, each apex with two short spines; body beneath brownish, the abdomen darker, very glossy; legs with long stiffish hairs. Length 6 lines.

LIMOZOTA.

Antennæ muticæ; tuberibus antenniferis approximatis.
Prothorax cylindricus, elongatus, lateraliter inermis.
Elytra parallela; apicibus emarginatis, haud spinosis.

The type of this genus is well known under M. Chevrolat's name, *Mallocera virgata*; but from *Mallocera* it differs in every one of the above diagnostic characters. The head is very short in front, its breadth being considerably increased by the large prominent eyes; the antennæ are twice as long as the body in the male, and without any trace of spines; the prothorax is slender and cylindrical, with three small tubercles on the disk, giving it that "personate" appearance of eyes and nose, and sometimes of mouth, so common in this subfamily; the elytra are narrow, parallel, and rounded at the apices; the legs are somewhat slender, the femora slightly thickened, but not clavate; the basal joint of the posterior tarsi slender, and not longer than the two next together.

Limozota virgata.

L. pallide flavescens; elytris lineis flexuosis brunneis ornatis.

Hab. Columbia.

Pale yellowish or straw-colour; head and prothorax with a close greyish pubescence mixed with long hairs; the prothorax with two black, round, shining tubercles on the disk, and an oblong one behind them; scutellum smooth, cordate; elytra with scattered hairs only, irregularly punctured, one principal

flexuous line from the shoulder to near the apex throwing off two transverse branches, one behind the shoulder, the other near the middle; body beneath, legs, and antennæ fulvous, covered with long slanting hairs. Length 8–10 lines.

The genus *Centrocerum* (Dej.), described by M. Chevrolat in the French 'Annales' (1861, p. 189), and which has for its type *Elaphidion exornatum*, Newm., approaches in coloration some species of *Sphærion*—*S. Poëyi*, for example. A Bolivian Longicorn was afterwards distributed by the late M. Deyrolle under the same generic name. It belongs, however, to a very distinct form, which, in its entire anterior acetabula and elongated prothorax, approaches the Ibidioninæ. It may be named and characterized as follows:—

Rhysium.

Antennæ muticæ.
Prothorax oblongus, subdepressus.
Elytra angusta, apicibus rotundatis.
Mesosternum declive.

The head is short and concave in front; the antennary tubers are stout and divergent; the eyes are broadly emarginate; the antennæ are without spines, as long as the body in the female, and half as long again in the male, the scape is subpyriform, the third joint is twice the length of the scape in both sexes; the rest of the joints in the female are not longer than the scape, in the male they are considerably longer; the prothorax is oblong, broader in the middle, its disk marked with three nearly obsolete tubercles; the elytra are narrow and elongate, and rounded at the apices; the legs are compressed, the femora thickened, the four posterior tarsi equal; the pro- and meso-sterna depressed, the latter elongate. For the only known species I have adopted M. Deyrolle's name.

Rhysium bimaculatum.

R. brunneum, nitidum, sparse griseo pilosum; singulis elytrorum macula mediana flava.

Hab. Bolivia.

Glossy brown, inclining to umber, clothed with short, scattered, greyish hairs; the elytra with a large yellowish spot on the middle of each; head roughly punctured on the vertex; prothorax nearly impunctate, covered with a loose greyish tomentum; elytra finely and irregularly punctured; body beneath, legs, and antennæ with a short greyish pile. Length 7 lines.

The position of the following genus must for the present be considered doubtful.

Alcyopis.

Caput valde exsertum; collo constricto.
Antennæ muticæ; tuberibus antenniferis validis, intus productis, basi contiguis.
Prothorax elongatus, cylindricus, irregularis.
Mesosternum antice productum.
Femora clavata.

I have received the species constituting the type of this genus under the name of "*Sphærion cyanipenne*, Serv." But it is not that insect, nor can it be regarded as belonging to *Sphærion* at all in any sense, its head constricted behind the eyes giving it the aspect of a *Leptura*-form, and especially, if also we regard its colour, of *Rhamnusium salicis*; it has, however, entirely rounded anterior acetabula, and globose coxæ. The head is very short in front, the antennary tubers so projecting as to give that part of it a vertical direction; the scape is pyriform, the third joint the longest, and the fourth shorter than the fifth; the eye is broadly emarginate, the lower lobe large and prominent, the upper small and remote from its fellow on the vertex; the palpi have the terminal joint triangular; the prothorax is broader behind, its length half as much again as its breadth; the elytra are flattish, and nearly parallel at the sides, the apices each terminating in a median point; the femora are rather abruptly clavate, and the posterior and intermediate are equal and a little longer than the anterior; the mesosternum is strongly produced.

Alcyopis cyanoptera.

A. flavo-castanea, nitidissima; elytris læte cyaneis.

Hab. Brazil.

Bright yellowish chestnut, very glossy, nearly glabrous; head sparsely and finely punctured; prothorax impunctate, deeply and broadly constricted anteriorly; the disk behind the constriction with five prominent tubercles—one anterior and median, the two external prolonged beneath at the side; scutellum semicircular; elytra rich blue, very glossy, minutely and irregularly punctured, each apex terminating in a short median spine; legs and antennæ with scattered hairs, the latter rather longer than the body; sterna ferruginous; abdomen blackish. Length 10 lines.

LXIII.—*Notes on Dr. Bowerbank's Paper on* Hyalonema. By Dr. J. E. Gray, F.R.S.

I have no desire to enter into a controversy with Dr. Bowerbank on this subject, for I have always highly estimated him as an enthusiastic collector, a good microscopist, and always willing to communicate all he knows; and I shall be glad to study his promised paper, premising that I am not aware that there is much to be added on the subject to what has been said by Dr. Max Schultze, Dr. Brandt, and Senhor Bocage. At present I only wish to explain what Dr. Bowerbank calls my "misrepresentations."

To establish the first, Dr. Bowerbank, doubtless unintentionally, misquotes my paper, and makes me appear to say what I did not intend to convey. After referring to the zoologists who have regarded the "glass rope" of the coral as part of the of the sponge, in a *separate paragraph* I observed, "Dr. Bowerbank, adopting the same view," &c.; and, as I am always anxious to fairly represent what any one who differs from me on a scientific subject has to say, I quoted at length the characters that Dr. Bowerbank reprints in his note, and his other observations on the genus. So I do not see how I could misrepresent him.

Secondly, Dr. Bowerbank says I "misrepresent him," as I ought to have recollected that he examined the specimens of *Hyalonema* in the British Museum in 1860. I may observe that I do not keep any note or record of what specimen any visitor examines. Dr. Bowerbank appears to have confined his examination to the structure of the spicula, and it is only the spicula that are figured in the plates in the 'Philosophical Transactions' which he quotes. I can hardly call such a study of the specimens "a careful microscopical examination of their anatomical structure." If Dr. Bowerbank has examined anatomically the animal structure, it is most extraordinary that he did not discover that what he calls "the *oscula*" of his "cloacal system" were social *Zoanthi* with plicated stomachs, retractile conical tentacles, and all the anatomical structure of that type of animals—more especially as Professor Brandt, in his essay published in 1859, a year before Dr. Bowerbank's examination, had described and figured these parts in detail; and Brandt's observations have more recently been confirmed by Senhor Bocage.

Dr. Bowerbank is unfortunate in his observations on my paper. Thus he observes, "The fact of the presence of siliceous spicula in the inner coat of what he [Dr. Gray] terms the bark of *Hyalonema* should have warned him that it could not belong to either of the genera '*Corticaria*' (qu. *Corticifera*) or *Zoan-*

thus." It is Professor Max Schultze, MM. Milne-Edwards, Haime, and Valenciennes (all zoologists of great eminence) who regard the animal of *Hyalonema* as a parasitic species of *Corticifera* or, as they call it, *Palythoa*, or of *Zoanthus*; so it is these zoologists, and not I, that should have been warned; for I have always regarded the animal of the Glass Rope as a peculiar genus for the very reason Dr. Bowerbank assigns, and called it *Hyalonema*, the name he quotes! I can only consider this, like the other charges in his paper, a proof of the haste in which he must have penned his reply to my observations; and I am convinced that, when he has properly examined the anatomy of the specimen, and considered the subject, he will find that he cannot establish his theory against the unanimous opinion of such experienced zoologists. Indeed one cannot understand how Dr. Bowerbank ever could have fallen into the unaccountable zoological blunder of describing as an osculum of a sponge the large well-developed zoanthoid polype which had, before he published a word on the subject, been referred to its proper group by the celebrated naturalists above named, while its anatomy had been figured by Professor Brandt, unless it be assumed that he is very imperfectly acquainted with the literature of the subject on which he writes—an assumption that would explain many lacunæ in his work on British Sponges, and the fact of so many names in that work being followed by "Bowerbank:" in some entire pages the name occurs as every third word.

I think, if Dr. Bowerbank will read Senhor Bocage's paper with care, he will find that he has misunderstood it, and that Senhor Bocage does mean by the *thin end* the one that in the Japan specimen is inserted in the sponge; otherwise I should fear that Dr. Bowerbank lays himself open to the accusation which he makes against Professor Owen in his description of *Euplectella*.

Whatever theory may be entertained about the rope-like bundle of spicula which I consider the axis of the coral, there can be no doubt that the bark on the axis is a zoophyte allied to *Zoanthus*. Dr. Bowerbank alone amongst naturalists denies this fact: he considers that "the basal sponge, the spiral axis, and its coriaceous envelope are really parts of one and the same animal," and that animal a sponge. He should recollect that this is not the first time he has made a mistake of the kind, as when he described the case of the egg of a leech as a sponge. I cannot but regard the "columnal cloacal system and its oscula" in *Hyalonema* as the myth of a microscopist.

Is Dr. Bowerbank certain that none of the Gorgoniadæ secrete *silica*? Some French zoologists have stated that they do.

LXIV.—*Venus's Flower-basket* (Euplectella speciosa). By Dr. J. E. Gray, F.R.S.

The British Museum has lately received a very beautiful specimen of this interesting siliceous Sponge. There are several other specimens in London; they were obtained from the Philippine Islands. The specimens are subcylindrical, varying a little in the extent to which they are dilated upwards, and in the width of the fringe round the upper aperture of the tube; they are all more or less curved on one side near the base. The base is evidently attached to some marine body, perhaps small shingle, as it is more or less dilated into a swollen oblong bag, formed of interwoven siliceous spicula, similar to but closer together than the longitudinal spicula of the body of the vase: this bag encloses a number of fragments of shells, small stones, and some sand; and in the fresh specimens it may be an expanded base attached to the mud and sand. The broad end of the tube is covered with a reticulated convex lid, which is also to be found in a sponge from Malacca, described by me under the name of *Aphrocallistes Beatrix* (Proc. Zool. Soc. 1858, p. 115, t. 11).

Like all showy and beautiful natural productions, it has had many describers; and there is a confusion in its history which, it is to be hoped, is not shared by that of many others.

This sponge was first described and figured, in 1833, by MM. Quoy and Gaimard, in the 'Voyage of the Astrolabe,' p. 302, Zoophytes, t. 26. f. 3, under the name of *Alcyoncellum speciosum*, from a very imperfect specimen which had lost the netted lid, the fringes on the outside, and a considerable portion of the smaller, lower end of the tubes. It was given to the travellers by M. Merkus, the Governor of Molucca. They observe: "En voyant l'élégante blancheur et la régularité d'un tel tissu on a de la peine à se persuader, qu'il est le produit d'une réunion d'animaux. On aime mieux en voir un seul au fond de la mer travailler à se faire ce logement pour un but quelconque, en tirant de sa propre substance, comme le font certaines chenilles, la matière qui se pétrifie aussitôt qu'elle est en contact avec l'eau" (p. 303).

There can be no doubt of the imperfect state of this sponge, from a comparison with a worn and crushed specimen in the British Museum, that was obtained by Capt. Sir Edward Belcher, and purchased at the sale of his shells.

MM. Quoy and Gaimard refer the sponge to the genus *Alcyoncellum* of De Blainville, and quote at length the generic character given by that author. A very cursory reading of that character shows how little it fits their specimen; and it is very difficult

to understand how and why they referred it to that genus, which seems to have been established on another sponge which they brought home, and which is not noticed in the 'Zoology' of their 'Voyage;' hence we can only suppose that it was overlooked.

In 1836, M. Milne-Edwards, in the second edition of Lamarck's 'Histoire Naturelle des Animaux sans Vertèbres,' vol. ii. p. 588, adds, at the end of the Sponges, a note on the genus *Alcyoncellum*, obviously compiled from Quoy and Gaimard's imperfect figure: he refers to *Alcyoncellum speciosum* of the 'Voyage of the Astrolabe' as the type, evidently overlooking the original description of the genus in Blainville's 'Zoophytes,' quoted in Quoy and Gaimard's work.

In 1841 Professor Owen, in the Transactions of the Zoological Society (vol. iii. p. 203, t. 13), described and figured a nearly perfect specimen, under the name of *Euplectella aspergillum*, which was obtained by Mr. Cuming in the Philippines, and is now in the British Museum; and in the Transactions of the Linnean Society (vol. xxii. p. 117, t. 21) he describes and figures a very nearly allied species, under the name of *Euplectella cucumer*, from a specimen (in the collection of Dr. Farre) which was obtained from the Seychelle Islands.

The genus *Alcyoncellum* was established by De Blainville, in 1832, in the 'Dictionnaire des Sciences Naturelles,' and again in his 'Manuel d'Actinologie,' p. 529, on a marine specimen brought to Paris by MM. Quoy and Gaimard, with the following characters:—"Body fixed, soft, gelatinous, solidified by tricuspid spicules, tree-like, with few branches, cylindrical, fistulous, with a terminal orifice; the substance thick, composed of regular granules, polygonal, alveoliform, pierced with an exterior and internal pore." The type is *Alcyoncellum gelatinosum*, figured at t. 92. f. 5 of the Atlas of plates to the Manual. It is clear from the above description that it has nothing in common with *A. speciosum*; and *A. gelatinosum* seems to be most probably a calcareous sponge nearly allied to the genus *Grantia* of Fleming.

Professor Owen's description and figure of *Euplectella aspergillum* leave little to be desired. The cornucopia is put on the plate with the broad end downwards. Perhaps the artist was deceived by the name "*Aspergillum*," and thought that, like the shell so named, the sponge lived with its broader, fringed, and perforated end sunk in the sand. In the figure of *E. cucumer* the sponge is represented erect and attached. Professor Owen, by a slip of the pen, writes Quoy and Gaimard's *Alcyoncellum* as *Alcyonellum*, and then says the name cannot be used for the sponge, because Lamarck has applied the name *Alcyonella* to a genus "of freshwater Polypes."

Professor Owen, from the manner he quotes *Alcyoncellum gelatinosum* of De Blainville and *A. speciosum* of Quoy and Gaimard, evidently considers that they are synonyms of the same species instead of two genera belonging to different families of sponges. He gave a new name to the genus because the specimen figured by Quoy and Gaimard had neither a netted lid to the tube nor fringes; but this only arose from the imperfect state of their specimen; the new name, however, was required in consequence of their mistake in referring it to the genus *Alcyoncellum* of De Blainville.

Dr. Bowerbank, in the 'Introduction to the British Sponges,' which is chiefly a reprint of his papers in the 'Philosophical Transactions,' makes some observations on this beautiful sponge, and is very severe on Professor Owen, accusing him of a mistake he did not make, because he called the widest part of a cone its base. As usual, when he leaves his microscope and goes to the book, he is in confusion. He at once sets aside Professor Owen's generic name, and adopts that used by MM. Quoy and Gaimard; but it is easy to see how this mistake arose. In consulting their work he entirely overlooked the generic character quoted from De Blainville. He evidently does not know, or at least quote, the 'Manuel' of M. de Blainville; nor does he recognize the figure of the sponge on which the genus *Alcyoncellum* is established, either under the name of *Euplectella* or *Grantia*. Dr. Bowerbank quotes the generic character of *Alcyoncellum* given in Lamarck as "the generic description of Quoy and Gaimard." He gives, as the type of the genus *Euplectella*, "*E. corbicula*, Quoy and Gaimard," a name not to be found in their work; he goes on to regard *E. corbicula* and *E. speciosa* as two species, and he thinks that *Euplectella* is a parasitic sponge, and clings to other marine bodies. But it is useless to continue to quote "the singular number of errors into which he has fallen in the description of this beautiful sponge," as he says of Professor Owen.

A crab is generally found in the cavity of the sponges. The Spaniards in Manilla regard them as formed by the crabs for their protection, and they do not consider the specimens perfect unless a crab is contained therein. I have, within the last few days, had a pair offered to me for an extravagant sum (£200), because they contained the crab that formed them. The crab must take up its place in the tube before the network in the upper end of it is formed, as, when that part is added, it becomes imprisoned in the tube.

The synonyms of the genus and species are as follows:—

Alcyoncellum, sp., Quoy & Gaimard; not Blainville, 'Zoophytes,' 1832, nor 'Manuel,' 1834.
Alcyoncellum, Milne-Edw., Lam. An. s. Vert. ed. 2. ii. 389 (1836); Bowerbank, British Sponges, i. 174.
Alcyonellum, Owen (misprint).
Euplectella, Owen, Trans. Zool. Soc. iii. 203 (1841); Trans. Linn. Soc. xxii. 117.

1. *Euplectella speciosa* (Venus's Flower-basket).

Alcyoncellum speciosum, Quoy & Gaimard, Voy. Astrolabe, iv. 302 (Zoophytes, t. 26. f. 5); Lam. Anim. s. Vert. ii. 389.
Euplectella aspergillum, Owen, Trans. Zool. Soc. iii. 203, t. 13.
Alcyoncellum aspergillum, Bowerbank, Brit. Sponges, i. 177.
Alcyoncellum corbicula, Valenc. Mus. Paris; Bowerbank, British Sponges, i. 176.

Hab. Philippines.

2. *Euplectella cucumer*, Owen, Trans. Linn. Soc. xxii. 117, t. 21.

Hab. Seychelles.

BIBLIOGRAPHICAL NOTICE.

The Record of Zoological Literature. 1865. Vol. II. Edited by ALBERT C. L. G. GÜNTHER, M.A., M.D., Ph.D., F.Z.S., &c., Van Voorst, 1866.

OUR readers, from the review which we last year gave of the first volume of this work, will know that the "the object of the 'Record' is to give, in an annual volume, reports on, abstracts of, and an index to, the various zoological publications which have appeared in the preceding year; to acquaint zoologists with the progress of every branch of their science in all parts of the globe; and to form a repertory which will retain its value for the student of future years." In all these respects the second volume fully bears out the promise of the first. The 'Record' is, in fact, invaluable; and zoologists owe a debt of gratitude to Dr. Günther and his coadjutors for the able way in which they carry out the task which they have proposed to themselves, and for the benefit which they thus confer upon their brother naturalists. The volume now before us contains a brief (necessarily very brief) summary of all that has been written in 1865—the cream, in fact, of no less than 35000 pages of zoological literature. It consists of a bulky octavo of 800 pages, and thus exceeds in size the 'Record' for 1864 by nearly one fourth. The reports on the Cœlenterata and Protozoa, which were omitted in the first volume, are now supplied for the year 1864 as well as for 1865. A slight change has been made in the list of Recorders: Dr. Cobbold and Mr. J. Reay Greene have ceased to take part in the work; and the cooperation of Dr. E. P. Wright has been secured, who has taken in hand

those classes on which the previously named gentlemen had last year reported, as well as the Cœlenterata and Protozoa.

We would especially call the attention of the editors of scientific journals and that of the secretaries of the learned societies to a very important plea urged by Dr. Günther in his Preface. Probably there is no zoologist among our readers who has been in the habit of writing on any branch of natural history who has not experienced the great inconvenience which arises from the fact that the separate copies of authors' papers have, in this country, always been repaged, instead of retaining, as they ought to do, the original pagination either alone or side by side with the repaging of the separate pamphlet. In order to quote such papers, therefore, it has hitherto been necessary to refer to the journal from which each paper has been extracted. Now such additionally required reference is in all cases attended with inconvenience, and to the naturalist resident in the country often impossible. The result is (a paper received by us this very morning supplies an instance), when such authors' copies are in the hands of subsequent writers they are frequently treated and referred to as separate publications, and no allusion whatever is made to the original work in which the paper appeared, and where alone it can be generally consulted. Most warmly, then, would we commend the suggestion of Dr. Günther, that, "as regards separate reprints of papers from Journals, Proceedings, or Transactions of learned societies, a most excellent plan, adopted for many years by the K. K. Zoolog.-botanische Gesellschaft of Vienna, and lately by the Zoological Society of London, should be more generally followed, viz. that of indicating the *original* pagination either at the bottom of the page or at the top within brackets. The value of separate copies is much increased thereby, as the time wasted in searching for the original pages is saved."

In the following table we give, first, the number of pages which relate to each class of animals in the volume before us, and, secondly, within brackets, the number of pages in the original publications of which the foregoing supply an abstract:—

Mammalia	53	(2400)	Insecta	330	(14300)
Aves	85	(3500)	Annelida	28	(800)
Reptilia	24	(1300)	Scolecida	12	(450)
Pisces	48	(3100)	Echinodermata	17	(600)
Mollusca	87	(4400)	Cœlenterata	16	(750)
Molluscoida	8	(300)	Protozoa	14	(1030)
Crustacea	60	(1500)			
Arachnida and Myriopoda	14	(480)			

It would be easy enough, no doubt, for a reviewer to find points for criticism as to imperfection in the analysis given of some particular work or paper, or to cavil at some expression of opinion on the part of the Recorder himself; but to do this would be most unfair. It would be difficult to find men more competent for their work than the several Recorders have proved themselves to be; and it is mere

justice to say that they have conscientiously, honestly, and ably discharged a most difficult task.

On a previous occasion we pointed out to our readers that it is impossible this work can be continued unless it be upheld by a large amount of support. Its publication is necessarily very costly; and an extensive sale is required to prevent a heavy loss falling upon that most enterprising of publishers, Mr. Van Voorst, from whose publications natural history has already received so great an impetus in this country. We cannot too strongly again insist upon the fact that it is the *duty* of every person interested in science, who can possibly afford to do so, to purchase the 'Record.' Dr. Günther and Mr. Van Voorst have commenced this annual solely in the interest of the progress of zoology; it remains for others, by their support, to enable them to continue it. The real student requires no instigation to purchase a book which he cannot do without, and the continued publication of which he knows to be of the greatest importance to himself; but, alas! the real scientific workers are few in number, and a sale among them alone would not suffice to prevent a heavy loss falling on the publisher, which would, of course, necessitate the discontinuance of the work. Let every friend of science, then, come forward and support the 'Record.'

It will give some idea of the character of the summaries of papers in the 'Record,' if we conclude this notice by giving an example. We shall select for this purpose what is told us in the two volumes on the migration of the mollusk *Dreissena polymorpha*. There are two mollusca, the steady diffusion of which has been the subject of most interesting and careful investigation for many years past. One of these, a marine Gastropod, is *Lottia testudinalis*, of which the gradual migration southwards down the eastern and western coasts of Great Britain has been clearly and distinctly traced. The other is one of the Acephala, *Dreissena polymorpha*. This is a freshwater species, nearly allied to the Mussel, which is rapidly spreading itself throughout the rivers and canals of this country, as well as those of the continent of Europe. The first volume of the 'Record' supplies us with the following particulars:—

"The immigration of *Dreissena polymorpha* into parts of Europe where it was originally unknown, has continued during the year 1864. Its occurrence in tributaries of the Rhine, Mosel, and Main is recorded by Messrs. Noll, Mandel, and Greim (Zoolog. Gart. Frankf. 1864, pp. 30, 89, and 124), with the addition of the dates of its first detection (1855–61); its presence in the middle part of the Rhine, at Knielingen near Carlsruhe, is testified by Hr. Kreglinger (Verh. ntrw. Verein. Karlsr. vol. i.); its appearance higher up in the Rhine, near Huningue, where it was found by Hr. Seul, is announced by Hr. P. Merian (Verh. ntrf. Ges. Basel, iv. 1864, p. 94); and, finally, its immigration into the Loire near Orleans, by way of canals, in 1864, has been observed by Capt. Morlet (Journ. Conch. pp. 309–314). Towards the end of last year the Recorder" (Dr. E. von Martens) "collected all the facts and observations concerning the immigration (or rather importation) of this mollusk which had

come to his notice, but the paper was not published until this year (Zool. Gart. Frankf. 1865, pp. 50–59, 89–97). *Dreissena polymorpha* is, according to Hr. Merian (*l. c.*) accompanied by *Neritina fluviatilis* in the Upper Rhine, where it never occurred before. The Recorder is enabled to confirm this by a communication from Prof. Braun, who says that it was not found in the Rhine near Carlsruhe some twenty years ago" (pp. 191–192).

In the second volume of the 'Record,' pp. 216–217, we have the following additional particulars on this most interesting subject:—

"Martens, E. v. Eine eingewanderte Muschel. Zoolog. Gart. Frankf. 1865, pp. 50–59, 89–95. *Dreissena polymorpha* was not known in the northern and western halves of Europe some forty years ago. The numerous treatises on the mollusk-faunas of these countries published at the close of the past and in the first two decades of the present century do not mention it. All at once it was observed for the first time in tributaries of the Baltic, the Niemen and Weichsel, in the year 1825, in tributaries of the Elbe in 1828, in the terminal branches of the Rhine in 1826, and in England in 1824. Several direct observations, and the comparison of the localities and times in which it has been observed for the first time in the several countries, establish the fact that it has been introduced into all those parts of Europe, along artificial, navigable canals, by means of ships or timber, and even across the Channel to England. The belief that it was observed already towards the close of the past century in south-western Germany is founded on a very superficial description of a shell by Sander and contradicted by the negative evidence given by Prof. Alex. Braun for the years 1824–46, and by Hr. Gysser for the present time, both agreeing in never having met with *Dreissena* in that part of Germany. As regards the rivers near to the Black and Caspian Seas, no reliable or sufficiently complete record of their faunas has been preserved from the commencement of this century; and there is consequently no reason to think that a recent migration has taken place into the Danube and the rivers of Southern Russia. At present it inhabits nearly all the tributaries of the Baltic, the Elbe upwards to Halle, the Rhine upwards to Huningue, the rivers of northern France, including the Loire, the British Islands, Hungary, a part of European Turkey, and almost the whole of Russia. It is very desirable that the attention of conchologists should be directed to the further advance of this shell, and that accurate statements should be made as regards the time at which it first appears in the lists of local faunas, not having been mentioned by previous accurate observers. This species is really a freshwater shell; it does not live in the Baltic itself, but only in the brackish water near the mouths of the rivers. The breakwater leading to the lighthouse at Swinemünde, for instance, is occupied on the river side by *Dreissena*, on the sea side by *Mytilus edulis*.

"Hr. Jäckel, Hr. C. Staude, and Dr. Fr. Buchenau have contributed further observations on this subject in the same journal, pp. 196, 228, and 278, in which they state that this shell is found at present in the Weser and in the Bavarian tributaries of the Main,

even in the canal by which the Main has been connected with a confluent of the Danube; so that *Dreissena* will shortly be an inhabitant of the upper and lower portions of the Danube without being found in the middle part of its course.

"Prof. E. A. Rossmässler, in his popular journal 'Aus der Heimath,' pp. 71–78 and 347–350, alludes to the same subject, principally its first appearance in Northern Germany, and states that the animal is able to detach the filaments by which it fixes itself to other objects, and that it is frequently found attached to the tail of crayfishes.

"Dr. Mörch (Ueber *Pinna fluviatilis* (Sander), Malak. Blätt. xii. pp. 110–117) defends his opinion (alluded to in the preceding note), viz. that a shell described by Sander in the year 1780 from a rivulet near Carlsruhe, is *Dreissena*, by an analysis of Sander's account, and by the analogous fact that the occurrence of the genus *Unio* in Denmark remained unknown to so careful an observer as O. F. Müller (1773). But we cannot accept this as a very convincing argument, inasmuch as *Unio* has been included in all the faunas of the surrounding countries published at that time (of the Baltic provinces, Russia, North Germany, and England); whilst *Dreissena* is not mentioned in any of them.

"Hr. A. Gysser (Mal. Blätt. 1865, Literatur-Blatt, p. 38) also discusses this question. He lives at the place indicated by Sander, and expresses it as his opinion that the rivulet is a locality unfit for *Dreissena*, that Sander's shell is a *Unio batavus*, his description entirely agreeing with specimens from that locality, with regard to size (two inches) as well as to coloration. A *Dreissena* of two inches would be a great rarity."

MISCELLANEOUS.

Theory of the Skull and the Skeleton.

To the Editors of the Annals of Natural History.

Gentlemen,—In the 'Reader' newspaper for the 24th of March of this year, Mr. Seeley published a letter containing an abstract of the paper, then recently read by him, which was published at length in the last Number of your Journal. After reading Mr. Seeley's communication, I wrote to the editor of the 'Reader' the following note, which was published on the 31st of March :—

"March 27, 1866.

"Sir,—If Mr. Seeley will refer to the 'British and Foreign Medico-Chirurgical Review' for October 1858, he will find, at the close of a criticism on Prof. Owen's 'Archetype and Homologies of the Vertebrate Skeleton,' a brief outline of the theory that the vertebrate skeleton is a product of mechanical actions, the effects of which have been continually accumulated by inheritance.

"The doctrine which I had there space to present in general outline only, is more fully worked out in the last number of the 'Principles of Biology,' issued in December 1865.

"Herbert Spencer."

Mr. Seeley having published his view in the 'Reader,' I concluded that he would see my letter; but I presume that he has not done so, since, in his contribution to your last Number, he makes no reference to the facts alleged in that letter.

Let me add that, while there is identity between Mr. Seeley's doctrine and my own, in so far as both ascribe the formation of bone to tensions and pressures, there is but little community between our interpretations of the physical process by which tensions and pressures have produced their effects.

HERBERT SPENCER.

37, Queen's Gardens, Bayswater,
Nov. 8, 1866.

On the "Fulcrum" of Calamoichthys.

To the Editors of the Annals and Magazine of Natural History.

GENTLEMEN,—I shall feel obliged if you can find space in your valuable Magazine for the following note.

In the abstract of my paper on the new Ganoid Fish from Old Calabar (*Calamoichthys calabaricus*), published in the 'Annals' for August last (No. 104), the word *fulcrum* has been unfortunately used, and may lead to a mistake. The anal fin is described as follows:—"anal (with fulcrum at base anteriorly) in male large, in female small, &c." The fin has a triangularly shaped and thickened portion, covered with scales, at the anterior base of the fin-rays; there are, however, no true *fulcral scales or bones*. The words within parentheses had therefore better be deleted. A detailed description of the fish is published in the 'Transactions of the Royal Society of Edinburgh,' vol. xxiv. part 2.

I am, Gentlemen,
Your most obedient Servant,
JOHN ALEX. SMITH.

Edinburgh, Oct. 29, 1866.

The Patagonian Finner. By Dr. BURMEISTER.

In August last a large Finner Whale was taken at the mouth of the River Plata, which I thought might be a *Sibbaldius*; but after studying the body more exactly, I think it is the same as the *Physalus* named *P. Patachonicus* in the Catalogue of Seals and Whales in the British Museum. I have made a good drawing of the animal; but the skeleton is lost, because it was impossible to preserve such a large animal, upwards of 58 feet long, without any assistance of good workmen, who are entirely wanting in the locality.

On the Phocæna communis *of the North Sea.* By Dr. J. E. GRAY, F.R.S. &c.

Professor Lilljeborg writes to me that the Porpoise (*Phocæna communis*) of the North Sea has "the front edges of the dorsal fin

finely denticulated near the end;" so that it appears to be the same as the species, described by Pliny and figured by Camper, that we have in the Thames, and which I described under the name of *Phocæna tuberculifera*. In the last edition of the 'Catalogue' (p. 402) I stated that the species without the spines on the dorsal fin appears to be very rare; and it is doubtful if it is a distinct form, and if my name will not have to sink into a synonym.

The Stuffed Whale in the Swedish Museum.

In reply to my inquiry, Professor Lilljeborg observes, "Vous m'avez prié de vous instruire de la méthode au moyen de laquelle la Balænoptère du M. Malm a été conservée. La peau de la même a été divisée en plusieurs morceaux, et a été depuis étendue sur un modèle de bois exactement de la même forme et grandeur que de l'animal lui-même. L'épiderme est conservé sur la peau, et il est pourtant très-peu lésé. La couche graisseuse de la peau a sans doute été très-menue, autrement l'épiderme en se desséchant aurait été plus plein de fentes et de rides qu'il ne présente maintenant."—J.E. Gray.

Observations on the Reproduction of the Cecidomyidæ. By F. Meinert.

In an article "On the Orgin of the Germs in the Larvæ of *Miastor*" (Naturhist. Tidsskr. ser. 3. vol. iii.) I maintain, in opposition to the opinion of M. Pagenstecher, that the germs of the larvæ originate in the adipose tissue. In another paper, entitled "A few more words on *Miastor*," after some remarks upon the formation of germs in another Cecidomyide larva, and on the formation and development of the ovum in animals in general, I more particularly indicate the relations of the germs to the adipose tissue. Here it must be remarked that we have to do with two different forms, species of two genera differing widely from each other, which have been the subjects of investigations made by different authors. I have been fortunate enough to be able to examine both forms; and as I was the first to classify the Cecidomyide examined by M. Wagner (*Miastor*), I have also succeeded in rearing the perfect insect from the larva referred to by MM. Pagenstecher and Leuckart, to which I give the following name and diagnosis:—

Oligarces. Haustellum nullum; palpi nulli. Tarsi 2-articulati. Antennæ moniliformes, 11-articulatæ. Alæ costis binis vel ternis abbreviatis, evanescentibus.

O. paradoxus. Ochraceus, capite atque mesonoto nigrescentibus. Femina: antennæ corpore quadruplo breviores. Ovipositor brevissimus. Long. 1·25–1·5 millim. Larva habitat sub cortice populi gregatim.

The cells which become developed into ova and germs, are usually in connexion with the adipose tissue, of which they form part; but whilst this union persists for a certain time in *Miastor* (Wagner's

larva), these cells, on the contrary, separate speedily to a certain extent from the adipose tissue in *Oligarces* (the larva of Pagenstecher and Leuckart), although they do not, as Leuckart maintains, constitute a true ovary either in *Miastor* or in *Oligarces*. In fact, all the cells become developed into ova and larvæ, and none of them serves for the formation of the stroma, for the formation of the envelopes of the ova, or for any other analogous purpose.

In order to explain the peculiarities of these animals, I have endeavoured to establish a theory of the formation and development of the ova in the whole animal kingdom, of which the following is an abridgemnt.

The ovum is composed either of a single cell, "the germinal cell," or of the germinal cell accompanied by several other "vitelline cells," or by the secretion of the latter, "the vitelline mass." The ovum of the Mammalia, and that of most of the inferior animals, belongs to the first category; that of other animals, and especially that of Birds, belongs to the second; and that of most Insects to the third kind. The "germinal cell" alone, the nucleus of which is the "germinal vesicle," is subject to the vitelline segmentation which is so often discussed. The "vitelline cells" and the "vitelline mass" are not segmented, but pass, without any other form of development, into the nutritive vitellus. The germinal cell divides by segmentation into minute cells (embryonal cells). A portion of these, not absorbed by the formation of the embryo, furnish material for the new ovaries and testes, inasmuch as in general some of the cells form a stroma which separates and encloses a greater or smaller quantity of the other cells. The remaining non-separated cells form, in Insects, what is called the adipose tissue.

A second element, the semen, is necessary in most animals, to enable the ovum, or rather the germinal cell of the ovum, to develope itself; but this stimulus is not always necessary in a great number of the inferior animals. The development of the ovum without stimulus or fecundation is by no means dependent upon a certain more or less advanced point of development of the maternal animal, or of its ovary; for sometimes the maternal animal attains a complete development even with external and internal genital characters (parthenogenesis, as in the bee), sometimes it propagates only in the state of a larva without genital characters, and this may be repeated through several generations, either under the same larval form (as in our Cecidomyides) or under a different exterior form (alternate generations or metagenesis—Trematoda). I by no means assume that there is any well-marked limit between parthenogenesis and metagenesis; for example, the mode of reproduction in the Aphides might be explained in both ways.

As compared with other insects, I also regard it as characteristic that, whilst in general we must make a distinction between the epithelial and vitelline cells, and the latter serve only for the nourishment of the embryo, in the present case the epithelial cells serve at once as epithelium and as vitelline cells to these larvæ.

I have thus given a summary of the principal results of my investigations, and shall only add that in the first part of my last treatise I have endeavoured to maintain my diagnosis of *Miastor* in opposition to Schiner, Siebold, and Loew. Whatever might appear to be remarkable in the fact that *Miastor* had only four joints in the tarsi and two joints in the palpi, vanishes before the circumstance that *Oligarces* has only two joints in the tarsi, and possesses no palpi at all.—*Ann. Sci. Nat.* sér. 5. tome vi. pp. 16–18.

A Last Remark on the Generic Name Potamogale. By Dr. A. Günther.

Dr. Gray, in a note "On the Use of the Genus *Potamogale*," published in the preceding Number of this Journal, p. 426, refers to the following remark, in which I had expressed my view on the same subject:—"Since he [Dr. Gray] has adopted the specific name of *velox*, given by Du Chaillu at the same time [as *Potamogale*], and as in this case the generic and specific names refer to the same individual specimen, succeeding naturalists have no other choice but to recognize or to reject both alike" (Zool. Record, ii. p. 33). He states that "the latter observation is incorrect," and "that the generic name of *Potamogale* and the specific one of *velox* do not rest on the same basis."

By this time all zoologists interested in the subject must be so fully acquainted with the history of this case, that the matter might have been safely left where it stands; however, as Dr. Gray says that I had come to this conclusion "on a very imperfect recollection of his paper," I must add a few words in further explanation.

In questions of this kind I am guided by a rule which is adopted by the majority of naturalists, viz. that "a name which has never been clearly defined in some published work should be changed for the earliest name by which the object shall have been so defined." Accordingly I asked myself, would it have been possible for a zoologist like Dr. Bocage or Prof. Allman to recognize *Potamogale* from Du Chaillu's original description, if the typical specimen (a mutilated skin, without skull) had been lost. I thought, and am still inclined to think, that identification would have been, for these zoologists, impossible or at least a matter of uncertainty, and therefore, that the first binomial name given by one of them should have superseded that proposed by Du Chaillu. In this respect I am so fortunate as to agree with Dr. Gray when he says, "M. du Chaillu's description of the *Cynogale velox* is so incorrect that, if the skin had not fortunately come into the possession of the British Museum, the animal must have remained . . . . one of the puzzles of zoologists" (this Journal, 1865, xvi. p. 426). For this reason I was and am still of opinion that both names might have been rejected alike, and that a new *binomial* name given by Dr. Gray would have been upheld by all naturalists adhering to the rule quoted above.

But in his last note Dr. Gray states, "The animal is described in

the paper (of M. du Chaillu), with some details, under the name of *Cynogale velox*, quite sufficiently, especially when one has the type specimen to confirm the description, to establish the specific name of *velox*." Although this may appear, at first sight, a contradiction of the previous passage, it is not so in reality, as in the first Dr. Gray argues on the assumption of the possible loss of the type specimen, and in the second this specimen is admitted as an essential item in the consideration of the matter. If the description, with the addition of the type specimen, be sufficient to establish the fact that the animal is swift, and therefore to justify the specific *velox*, that description with the type specimen was alike sufficient to establish the fact that it was a river-animal, and therefore to justify the generic *Potamogale*; for if a ——*mys* be admitted as a generic name for a carnivorous animal, a ——*gale* cannot be rejected for a suspected Rodent. Dr. Gray draws a line of distinction between the part of Du Chaillu's description referring to the species and that referring to the genus. I need not quote the passage again in which Du Chaillu justifies his proposal of the *genus Potamogale*: however unfortunate his comparison with *Cynogale* may have been, it implied at least that it was a *carnivorous* mammal; and he appealed to *the shape and proportion of the tail* and its *West-African habitat*. Surely many a generic name proposed and adopted by naturalists has been introduced into the system with less accurate elements of a generic diagnosis! Look, on the other hand, at his detailed description of the *species Cynogale velox*: it contains all those errors pointed out by Dr. Gray; nay, it is even perfectly insufficient as a *specific* description, such descriptions requiring considerable detail to ensure the distinction of a species from its congeners. If the type specimen had been lost, a succeeding naturalist, who might have recognized the *genus Potamogale*, would still have been at a loss to know whether he had to deal with the same species or not. And yet, although the chances of a recognition would have been more in favour of the generic than of the specific name, Dr. Gray prefers to use his advantage of having the type specimen for confirming the description and name of the species, rather than that of the genus. It was for these reasons that I stated my opinion that if one name be adopted, the other cannot be rejected; and for these same reasons I now state that the *generic name* has (on the merits of the original description alone) a better right to be adopted than the specific.

If zoologists should ever unite in the proposed revision of the "rules of zoological nomenclature," I shall not regret having been forced to this discussion, which may induce them to give a share of their attention to cases like the present.

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END OF THE EIGHTEENTH VOLUME.

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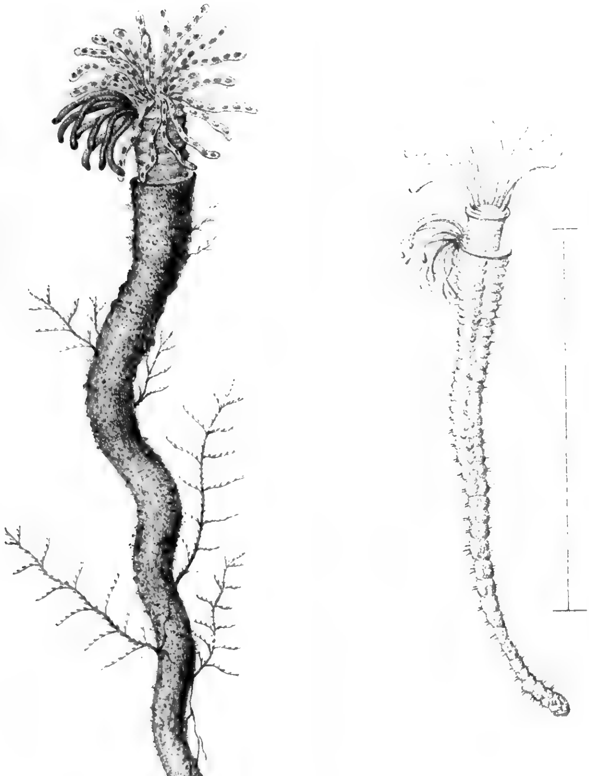

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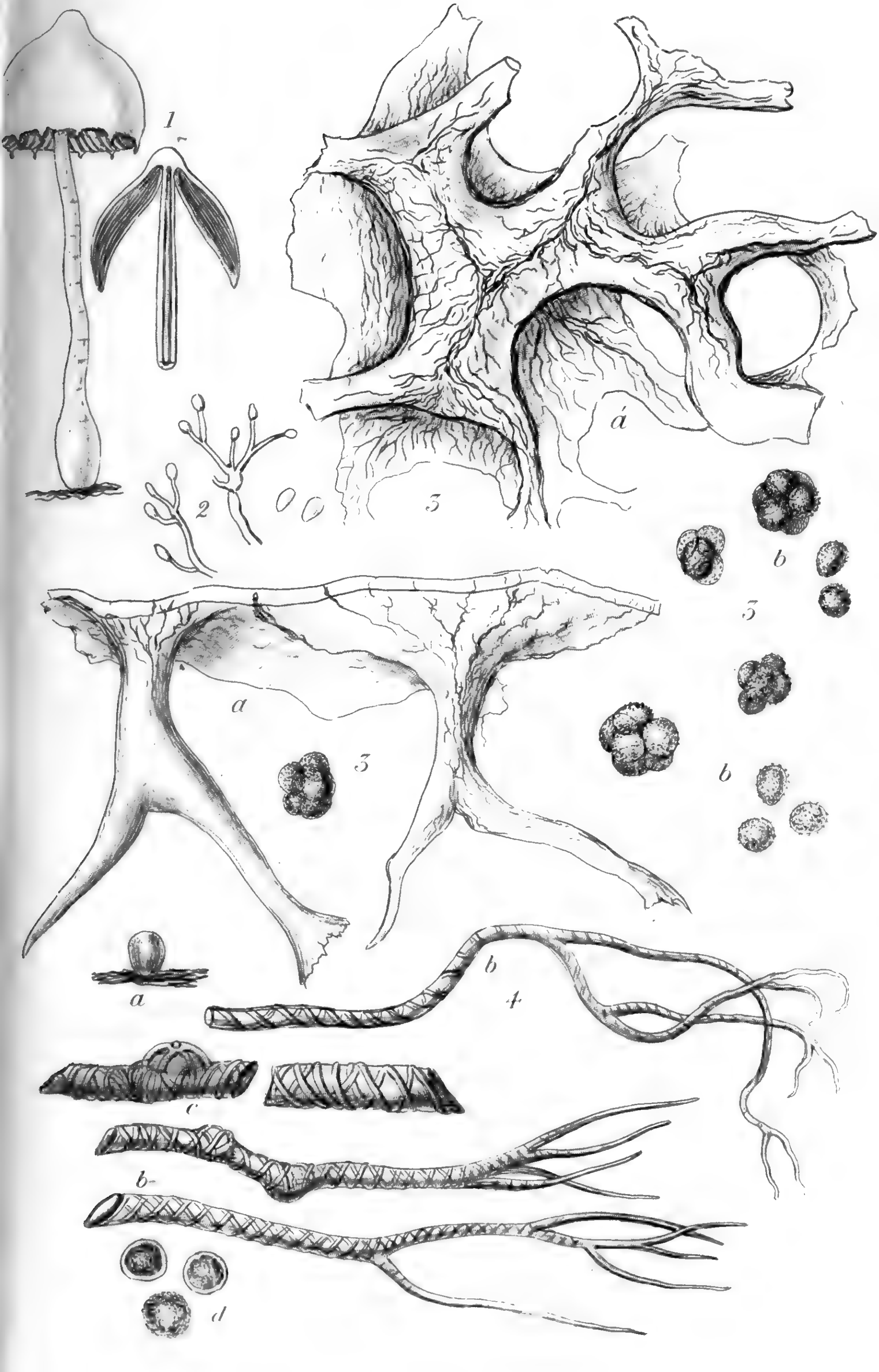

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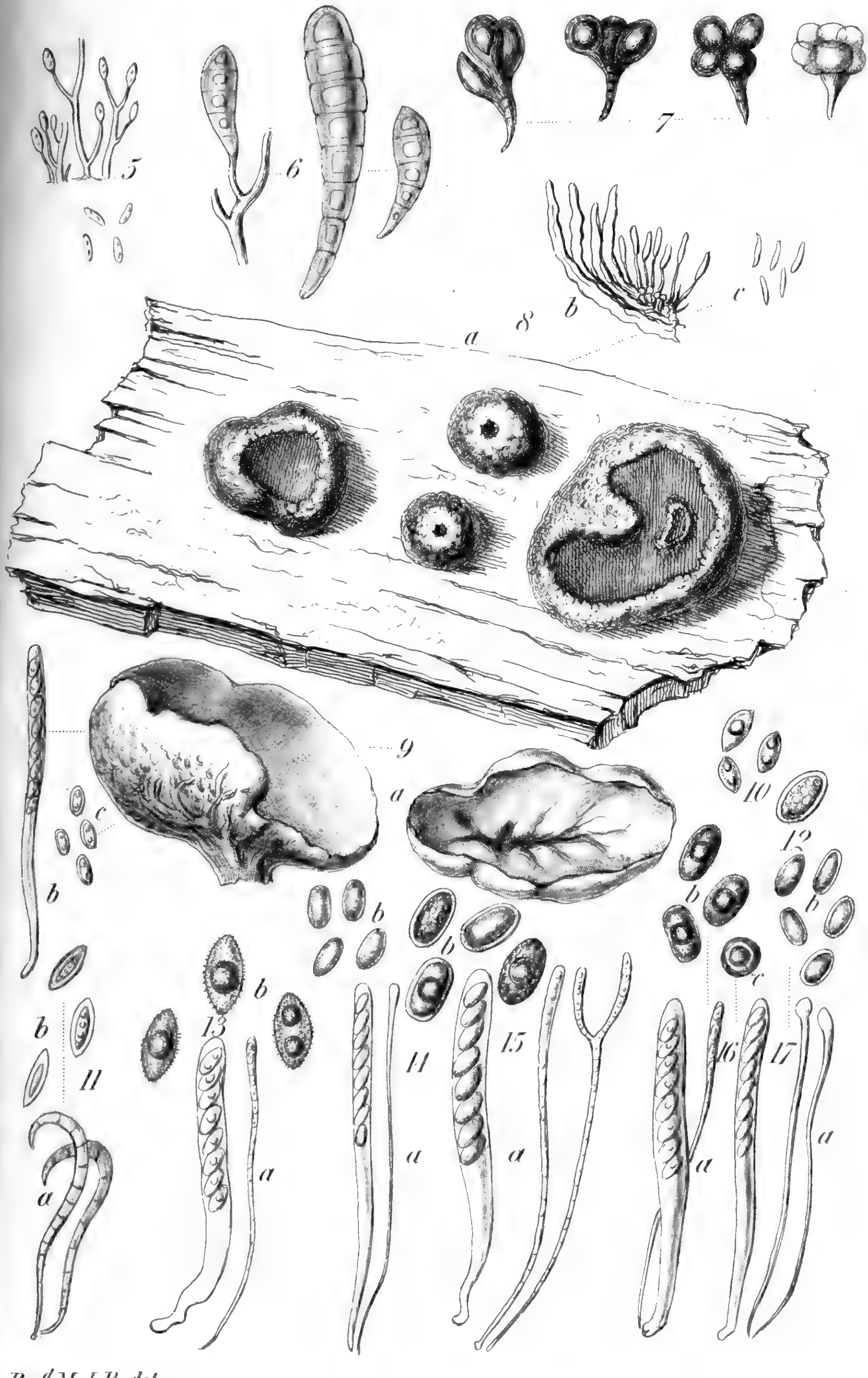

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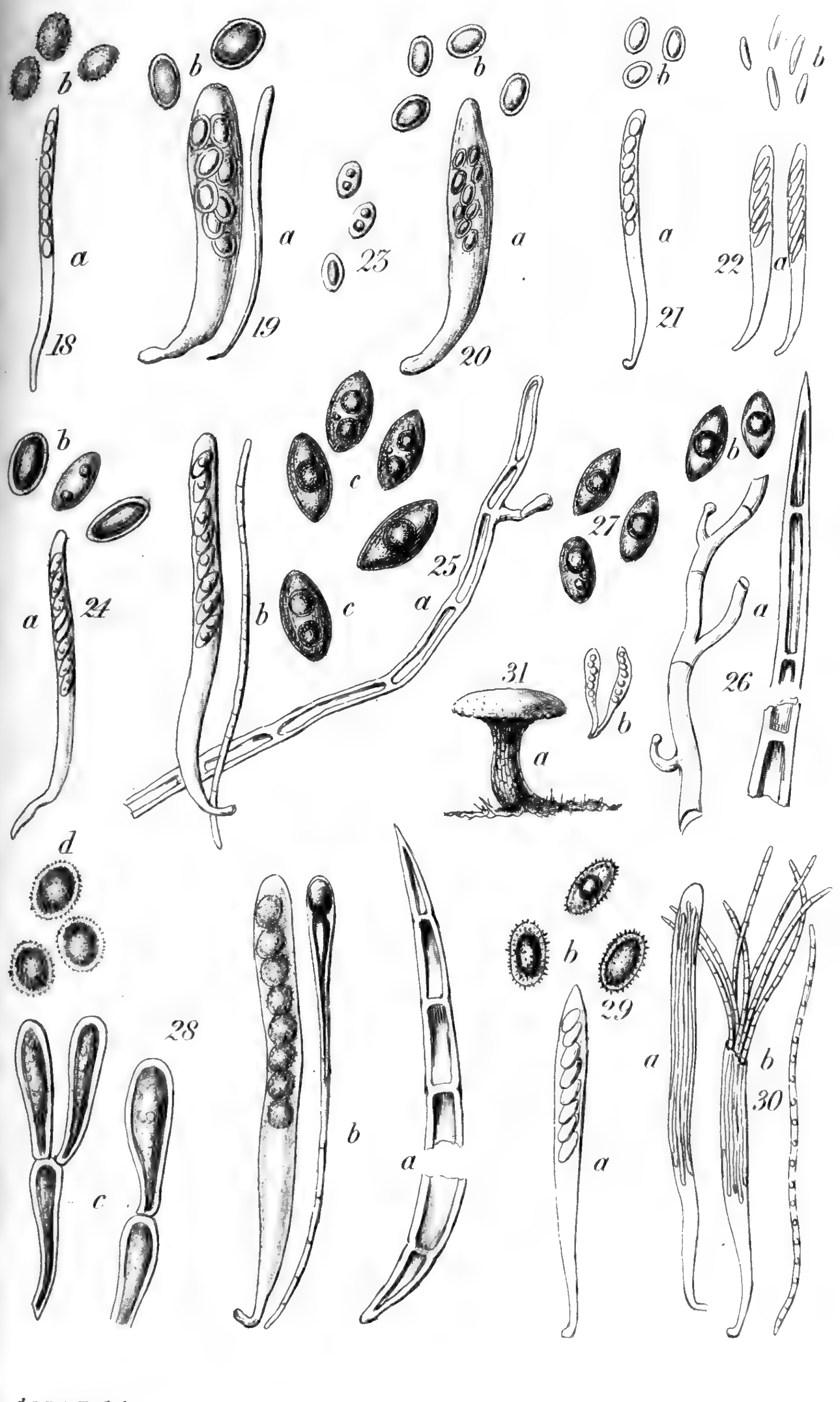

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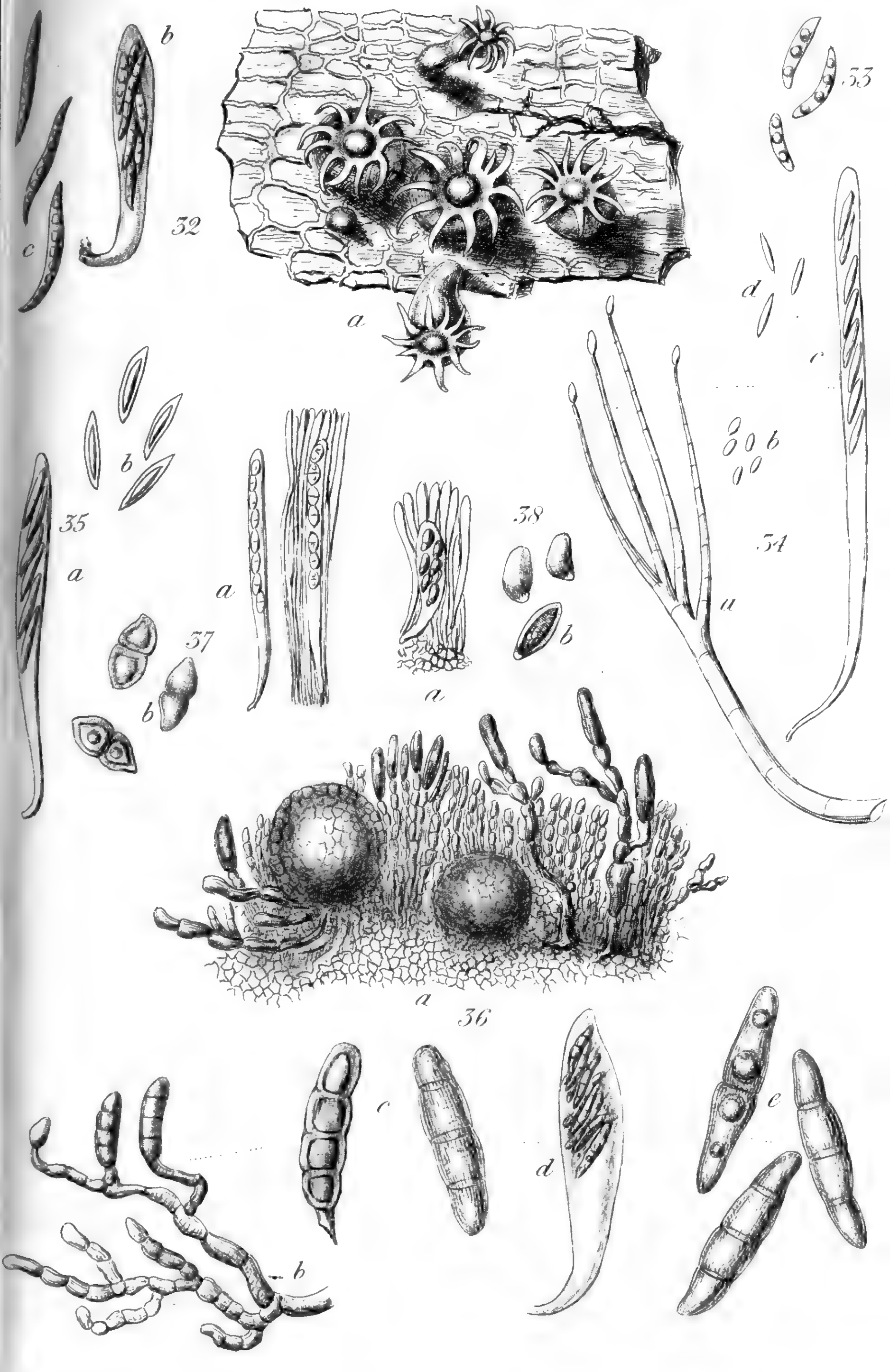

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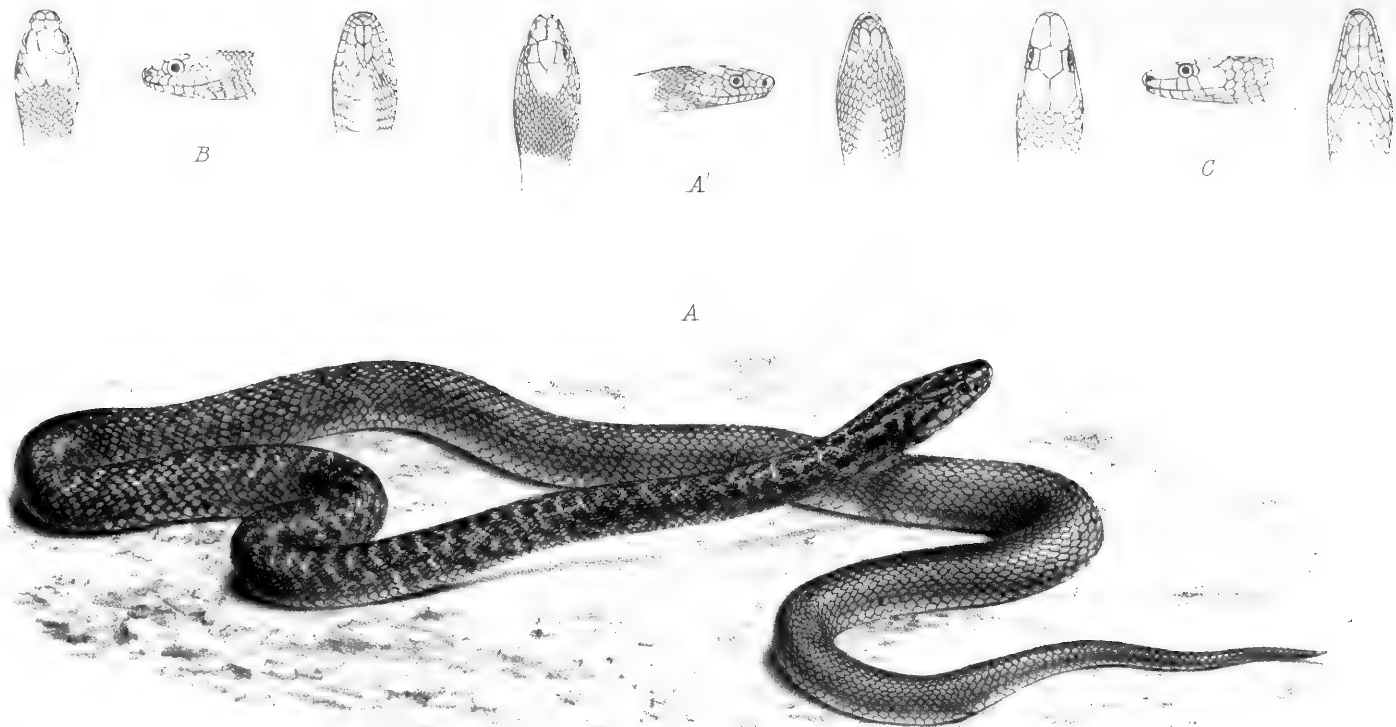

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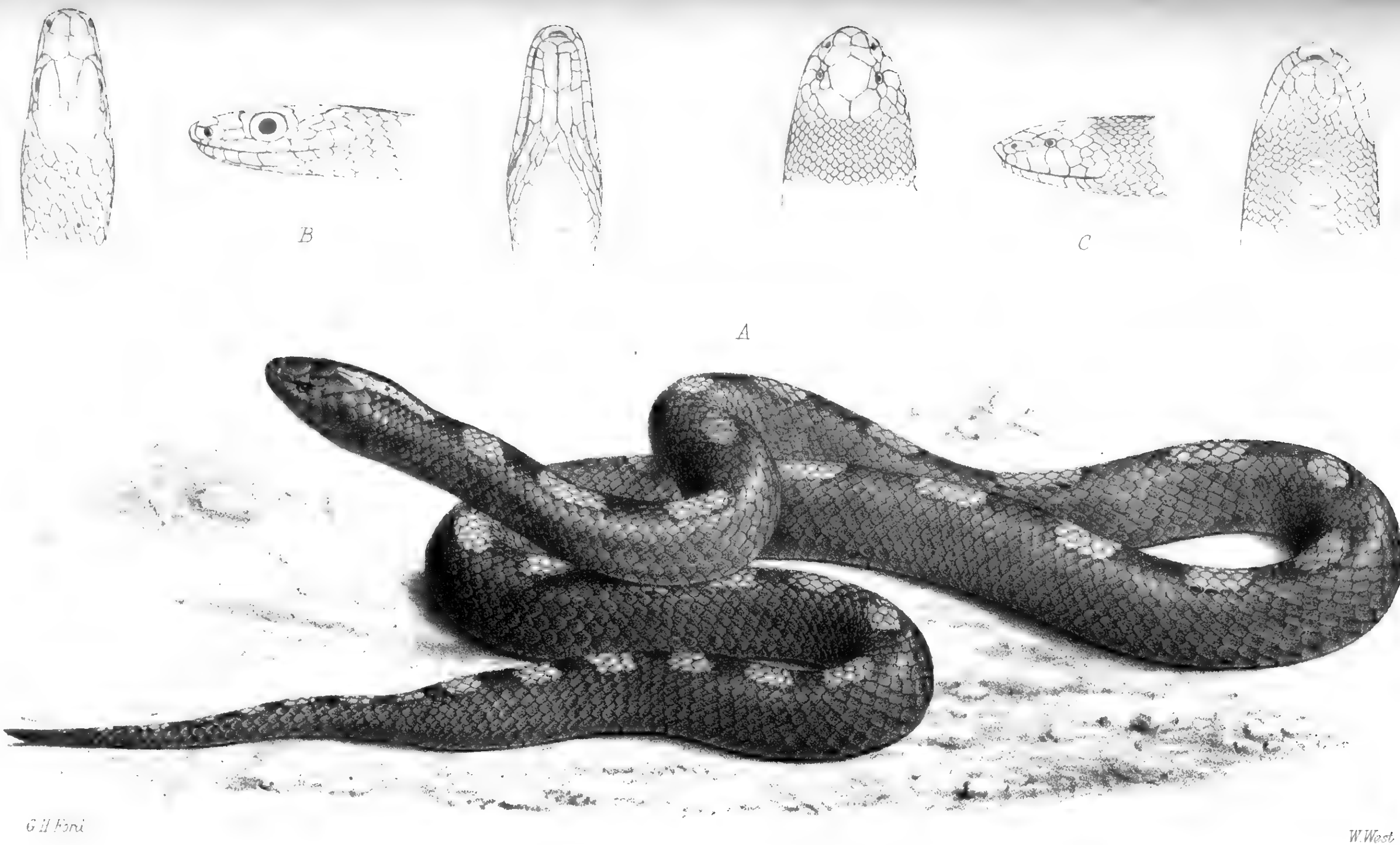

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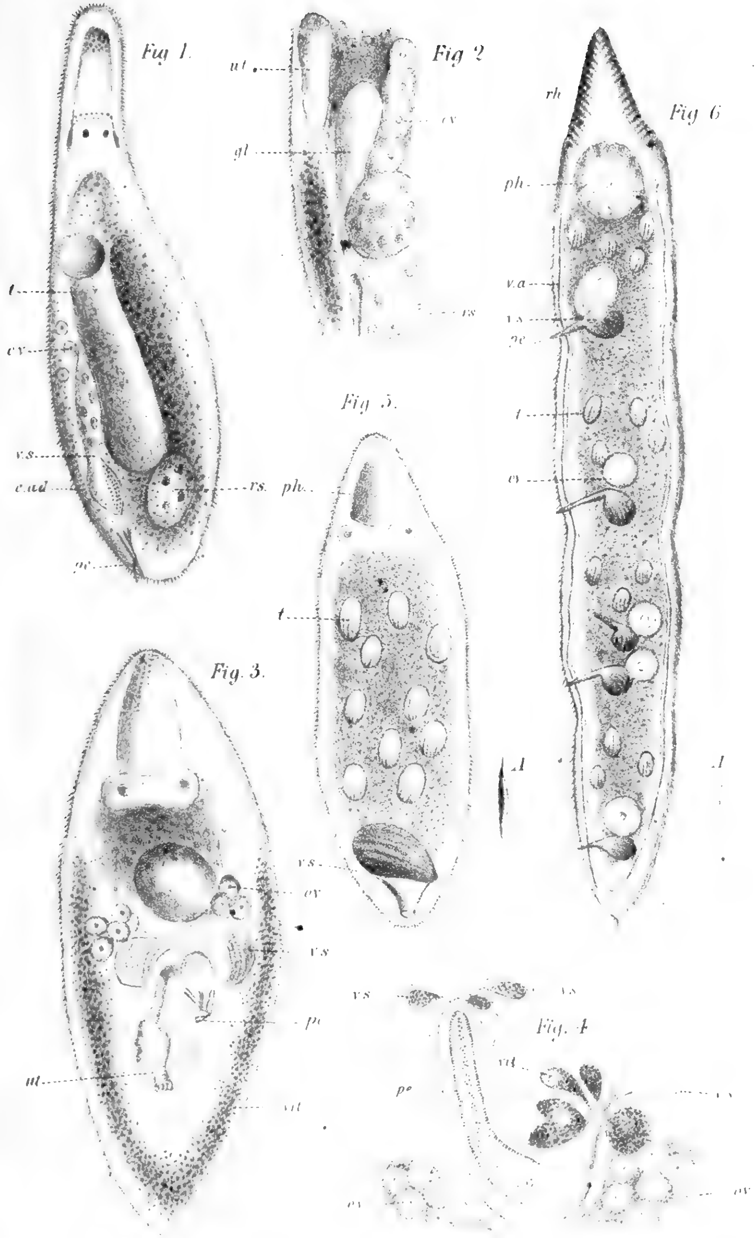
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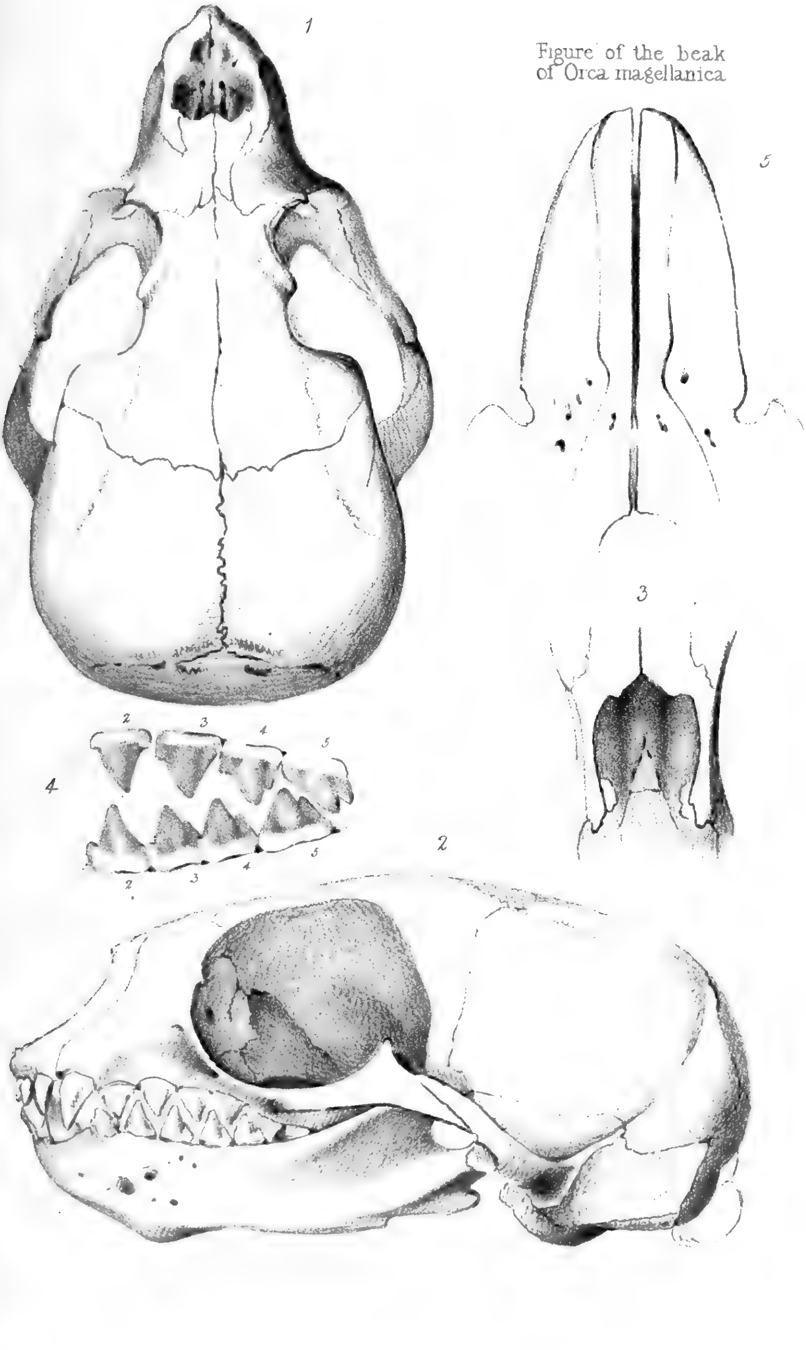

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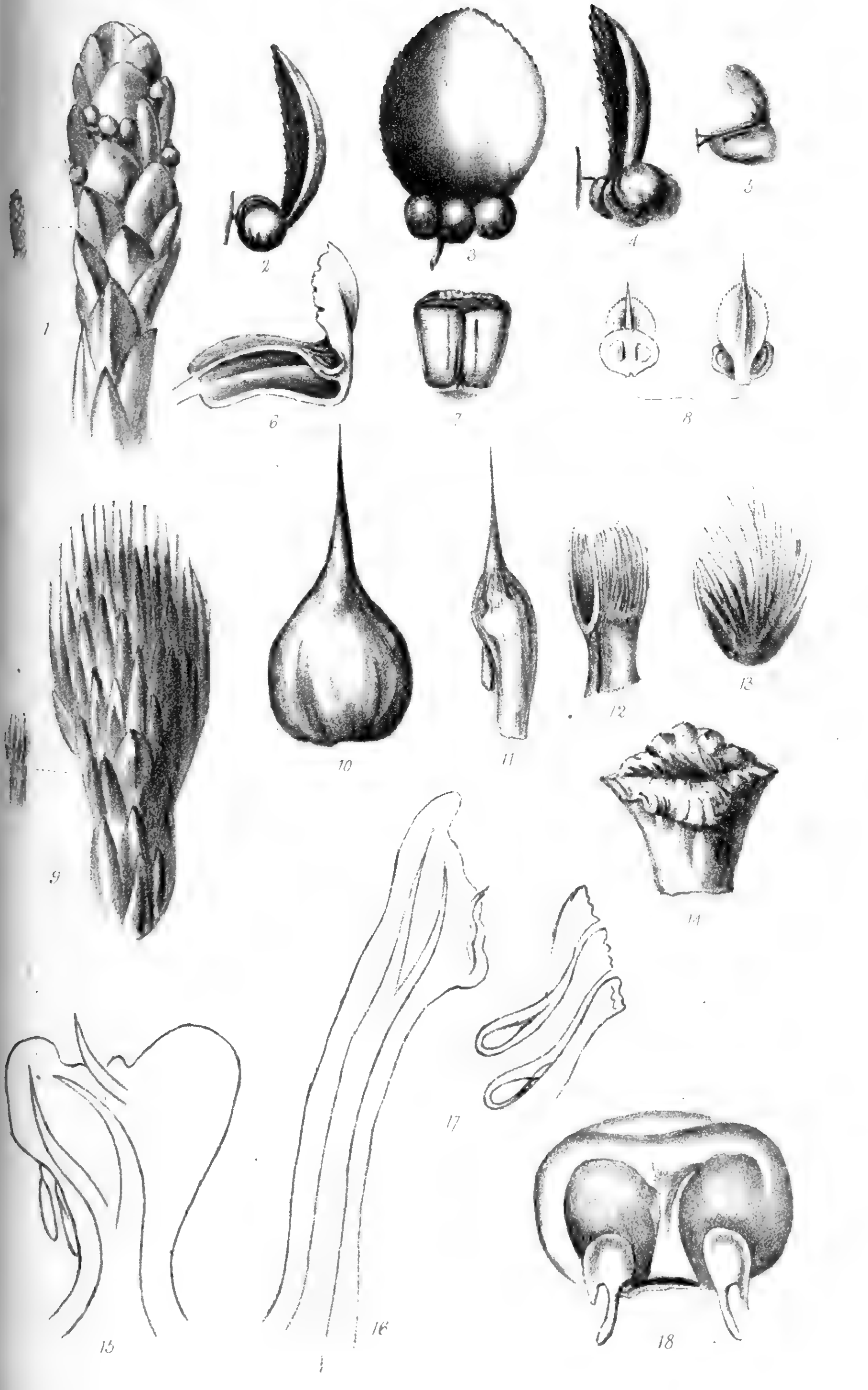

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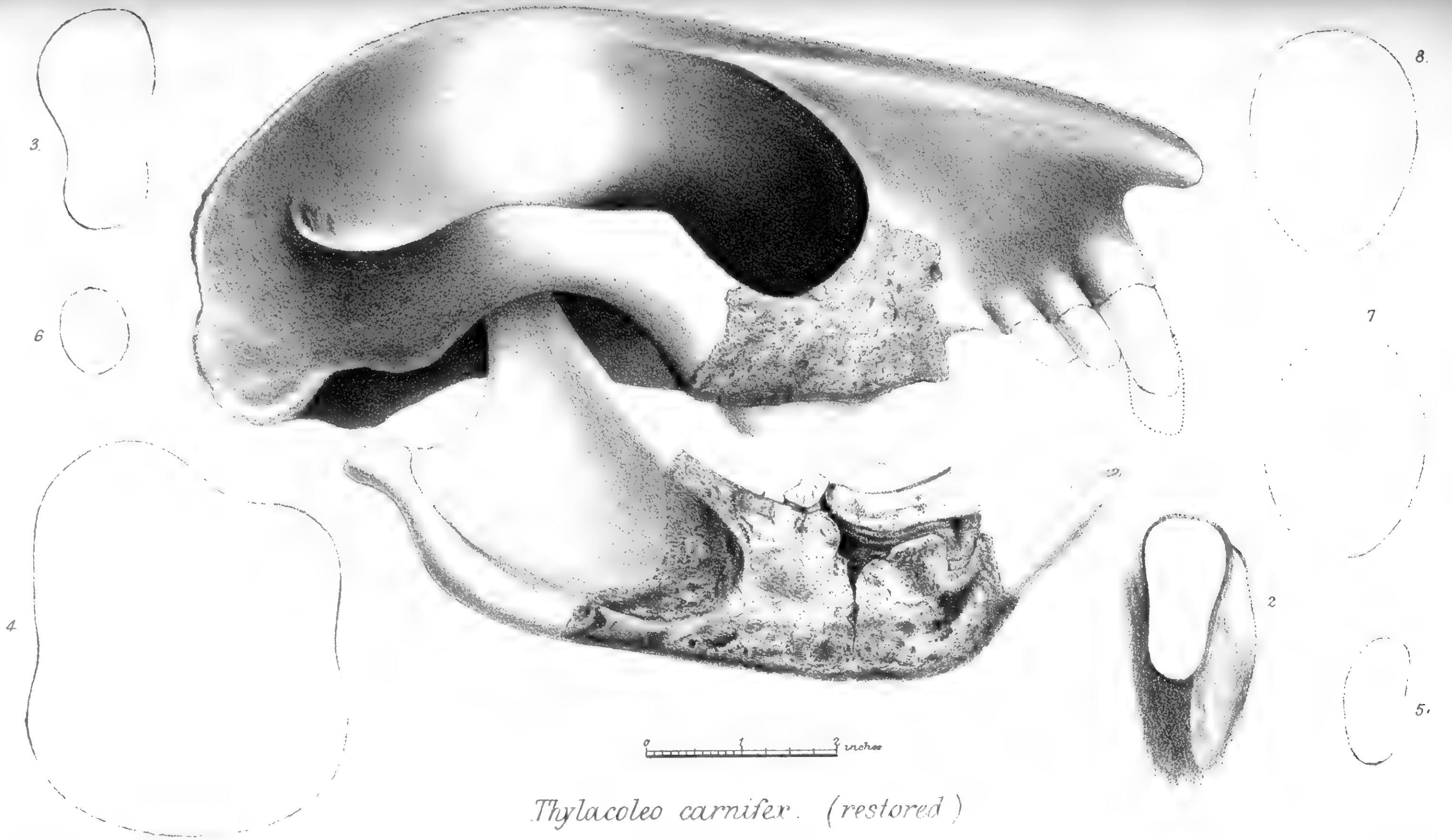

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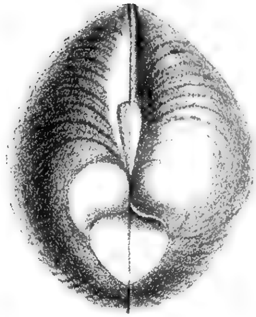

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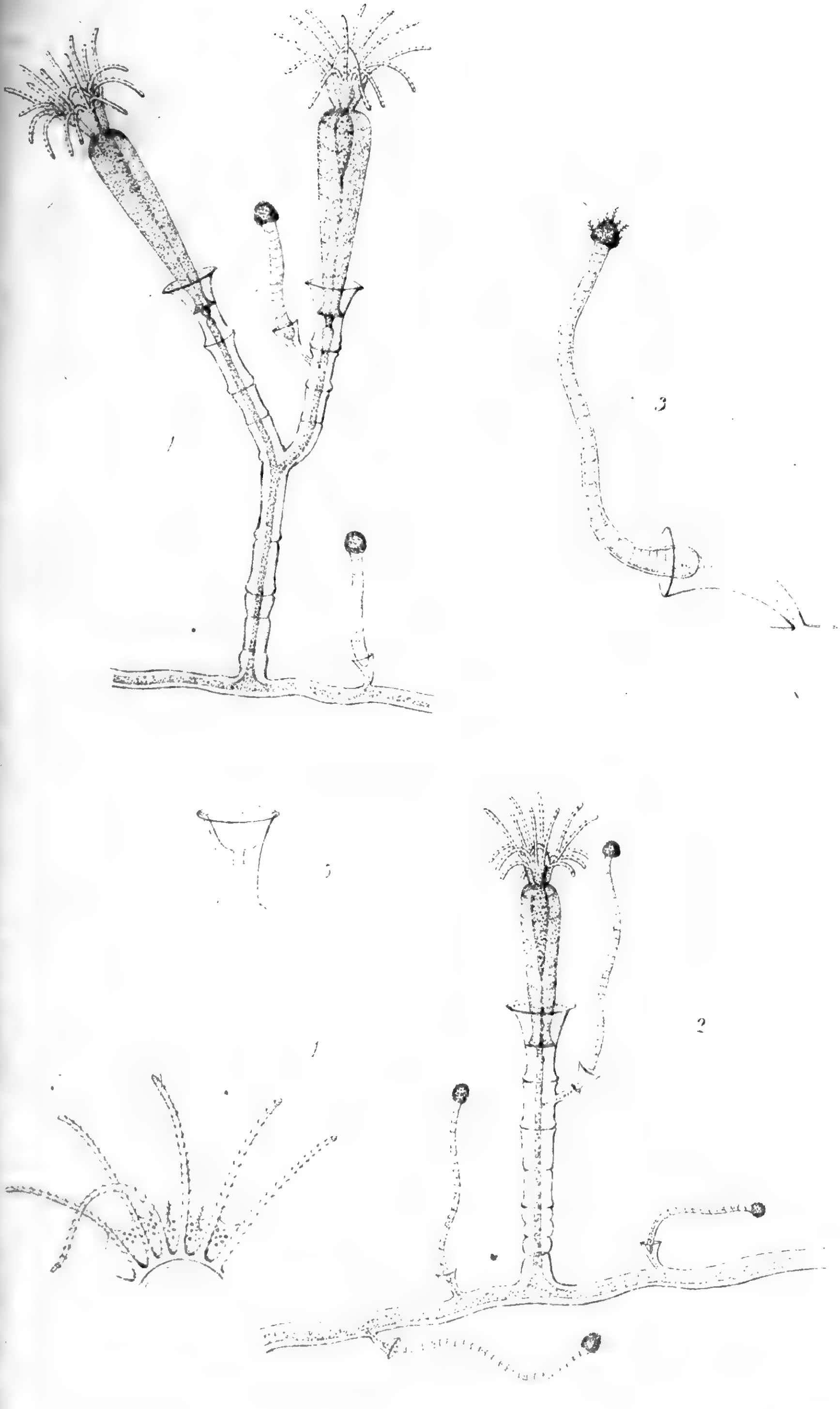
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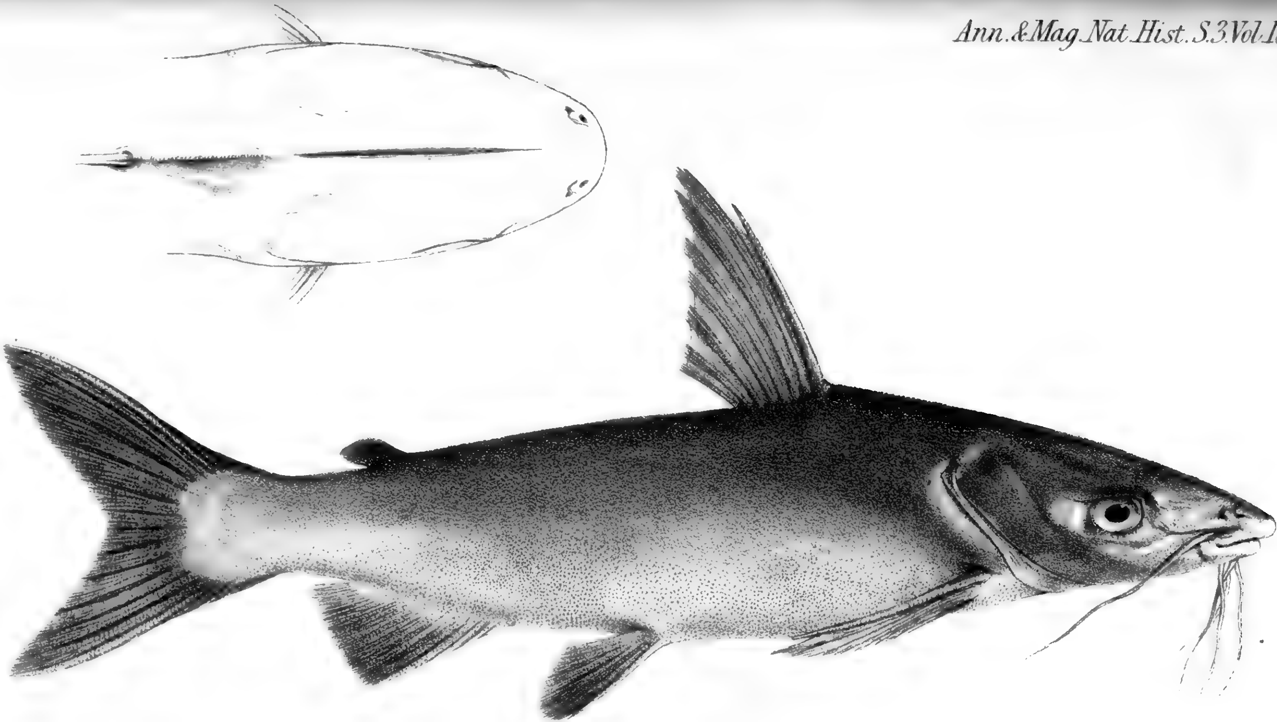

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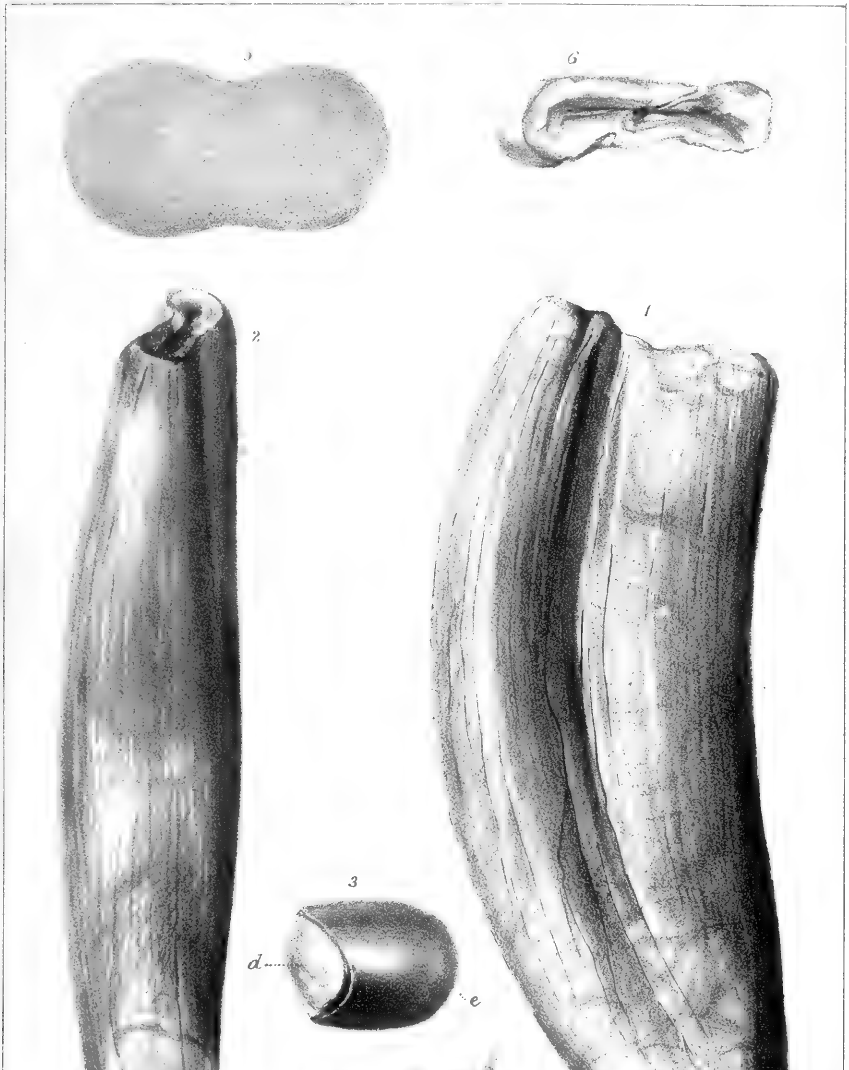

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